EVOLUTIONARY GEOLOGY AND THE NEW CATASTROPHISM

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Evolutionary Geology

and the

New Catastrophism

by

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Author of "The New Geology, a Textbook for Colleges," "The Fundamentals of Geology," "The Phantom of Organic Evolution," "The Predicament of Evolution," "God's Two Books," "Back to the Bible," "Q. E. D.," etc.

Geology

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PREFACE

WHAT may be regarded as the First Edition of the present work was issued privately by the author, as a pamphlet, in 1906, from Los Angeles, California, under the title: "Illogical Geology, the Weakest Point in the Evolution Theory." A revised Second Edition was issued in cloth, in 1913, under the title, "The Fundamentals of Geology." This edition was soon exhausted; but the World War came on, and it was impossible for the author to give attention to a much-needed revision; hence the Third Edition was issued with no revision.

Thus the present volume may be regarded as really a Fourth Edition of the book just mentioned. But the complete rewriting of much of the book, with the addition of a large amount of new material, has made this an essentially new work; I have therefore felt justified in again changing the title. It seems to me that the present title more truly designates the subject here discussed; and I do not think that anyone who has read its predecessors is likely to complain at finding here merely the same old facts and arguments that were given in the previous volumes. The line of argument is, indeed, the same; but a wealth of new facts has been added, which adds enormously to the strength of the argument. And if the leaders of geology, as well as the leaders in other departments of science, will henceforth display only

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common honesty in always differentiating between the facts of the rocks and the speculative theories regarding these facts, it can not be long before we shall have a very different situation in the scientific world regarding that vast theoretical incubus of organic evolution, which has so long fastened itself upon modern thought.

The recent publication of the author's Textbook, "The New Geology" (1923), has made unnecessary the further enlargement of certain parts of the present volume, which are allowed to remain much as in the previous edition. The publication of this Textbook has also relieved him of the charge that his work is wholly iconoclastic, and that the science of geology can not be taught without the evolutionary theory as an outline. In this "New Geology" the author tried to make a clear separation between facts and theories; if he has not wholly succeeded, it is because of the newness of this phase of the science and because of having to do this work of reforming the science of geology almost single-handed. Pioneer work is always difficult; but it is to be hoped that before long cosmological speculations will be considered as an anachronism even in geology.

GEORGE MCCREADY PRICE.

Bern, Switzerland.
June, 1926.

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PART ONE

Criticism

This map shows the front ranges of the Rockies in the region covered by the so-called "thrust fault" described in Chapter V. This region runs from the southern part of the Glacier National Park, in Montana, up past Coleman, Kananaskis Lakes, Banff, Lake Louise, Mt. Lyell, Mt. Hooker, up to Mt. Robson, the latter being the highest peak in the Canadian Rockies. All of these mountains are composed of Paleozoic limestones and quartzites, and rest in an almost horizontal position on Cretaceous beds, which run under the range from the eastern side, and in many places reappear again to the west of the mountains. There are no physical evidences to intimate anything except that these rocks were really deposited in the order in which we find them.

CHAPTER I

The Modern Onion-Coat Theory

I

For more than half a century some form of the evolution theory has been regarded as the only adequate explanation of the origin of the plants and animals, including man. That this theory has been and is now almost universally taught in the educational institutions throughout the world, is too well known to need any proof.

In support of this theory, various lines of argument have been advanced, from morphology and comparative anatomy, from heredity, from embryology, and from the study of the fossils, that is, from geology and paleontology. Of all these, the last named is the oldest and by all odds the most important. Indeed, as we shall see in some of the following pages, the prevailing theories of geology, which are more than a hundred years old, were the first to suggest the idea of a gradual development among the animals and plants; and, during all the time since, the facts (as they have been regarded) of an orderly succession of various kinds of animal and vegetable life that have inhabited the world one after another during many millions of years, have always been regarded by clear thinkers as the chief, the only indispensable, argument in favor of organic evolution. As William North Rice has expressed it, "The theory of a pro-

gressive evolution of forms of animal and vegetable life is absolutely dependent upon the succession of fossils in the geological strata.'"[1]

The various other arguments for organic evolution have been discussed by the present writer in another

FIG. 2. GEOLOGICAL CLASSIFICATION

GROUP	SYSTEM	SERIES	DOMINANT TYPE OF LIFE
Cenozoic	Quaternary or Post-Tertiary or Pleistocene	Recent Terrace Drift (Glacial)	Man
	Tertiary	Pliocene Miocene Oligocene Eocene Paleocene	Mammals
Mesozoic	Cretaceous	Upper or Cretaceous Proper Lower or Comanchean	Reptiles Conifers and Palms
	Jurassic	Upper (Malm) Middle (Dogger) Lower (Lias)	
	Triassic	Upper (Keuper) Middle (Muschelkalk) Lower (Bunter Sandstein)	
Paleozoic	Permian	Upper Lower	Amphibians and Coal Plants
	Carboniferous	Pennsylvanian Mississippian	
	Devonian	Upper Middle Lower	Fishes and Insects
	Silurian	Upper — Monroan Middle — Salina Lower — Niagara	Invertebrates
	Ordovician	Upper — Cincinnatian Middle — Champlainian Lower — Canadian	
	Cambrian	Saratogan Acadian Waucobian	
Primary or Primitive	Algonkian Archæan		Few Fossils or None

[1] *Methodist Review*, July, 1924, pp. 556, 557.

work.[2] Here it is proposed to consider in some detail the prevailing theories of geology, especially that theory upon which organic evolution is so absolutely dependent; namely, the idea that a long series of different kinds of animals and plants has occupied the world during an incalculably long period of time, and that scientists have been able to determine with accuracy and absolute reliability *the order* in which these successive types of life lived and died. For more than a full century, the world has been told that certain forms of life lived long before others came into existence, and that still other forms came into existence only long ages after these second ones had all disappeared; in short, we have been told that this *orderly sequence* among the various kinds of life is absolutely reliable, not as a mere theory, but as a historical *fact*. Our present inquiry is to determine, as best we can, the grounds on which this succession of life is based, and to examine this subject in the light of the well-established rules of inductive science, to see whether this definite order of succession among the fossils is a fact or only a theory; and if only a theory, to see how reliable it is in the light of modern geological discoveries.

It will be essential for my present purpose to assume that the reader is more or less acquainted with the elementary facts of geology. For the details regarding the stratified rocks and their fossil contents that are essential preliminaries to an understanding

[2] "The Phantom of Organic Evolution," New York, 1924.

of the present line of argument, I would refer the reader to my recently issued textbook.[8]

Here it will be in order for us to note how the geological *age* of any newly discovered set of rocks is determined by modern geologists.

II

On coming to any region that has not yet been examined and described, the investigator first determines the stratigraphical relationship of the various strata, following them from their outcrops as far as possible, noting any changes in the beds themselves, and especially in their fossil contents. Certain of these strata that have similar fossils are grouped together into what is termed a *formation,* which is the geological unit for classifying the rocks. The beds above this formation, or the ones below it, which have other kinds of fossils, will be regarded as having been made at some quite different time, the relative age being determined by the well-known principle that *the lowest beds must have been deposited first.* This is called the principle of *superposition;* for in any specific locality it is only a matter of common sense to say that the lowest beds are evidently the oldest. But whether these lowest beds were deposited thirty minutes before the beds above them or thirty million years before, will be a matter which we shall postpone for later consideration.

When the one or more formations in this new locality have been worked out and their fossil contents

[8] "The New Geology," A Textbook for Colleges, 1923.

determined, names are given to these formations, generally based on local geographical names; but these names have at first only a local or notebook value, until the fossils which they contain have been carefully compared with the fossils of other regions. If it turns out that these new fossils are like others already well known from elsewhere, the local names may have to give place to others more generally known and already accepted; and then these new strata are said to be the *equivalents* of these more familiar strata perhaps a thousand miles away. If these new fossils turn out to be considerably different in some respects from any collection hitherto known, they will probably be determined as *intermediate* (in general classification rank) between two well-known formations in some distant locality. In either event, these new beds will be correlated *as to the time of their formation* with other strata already known from elsewhere, as being either *equivalent* or *older* or *younger;* and thus they are assigned to a definite place in the long geological succession, and we are confidently assured of the particular period of geological history during which these beds were formed.

Two examples of how these methods work out in actual practice will be sufficient to illustrate this point. In 1902, the first fossil shells were collected on the antarctic continent. Out of about a dozen specimens, some were immediately recognized as ammonites belonging to genera found only in Cretaceous strata; or, to put the case in a more strictly accurate way, *all rocks in which any such fossil ammonites*

occur are always classed as Cretaceous. Accordingly, on the strength of these few ammonite shells, these rocks in the antarctic continent are declared to be of the same age as the Cretaceous beds of England and America.

The exact "age" of the Tampico oil beds of eastern Mexico was long held to be uncertain. But quite recently a single fossil rudistid pelecypod, *Sauvagesia degolgeri,* was found in these strata; and now we are

FIG. 3. Fossil Ammonites

assured by a prominent government expert that this single characteristic fossil "establishes the Cretaceous age of the San Felipe formation in its typical exposures west of Tampico."[4]

Hundreds of instances might be given of similar methods, where one or two "index fossils" have served to settle once for all the geological classification of extensive sets of strata. Grabau and Shimer have published two large volumes, entitled "North American Index Fossils," which are splendidly illustrated; and whenever a geologist is in perplexity as to the classification of certain beds, if he finds in these beds

[4] "Proceedings of the U. S. National Museum," T. W. Stanton, Vol. 59, p. 453.

certain representative "index fossils," he can settle the case in five minutes, with the help of these tabulated and illustrated examples. If, however, he does not have access to these rare and expensive lists of index fossils, the field worker can box up a few typical specimens of fossils and send them to the nearest

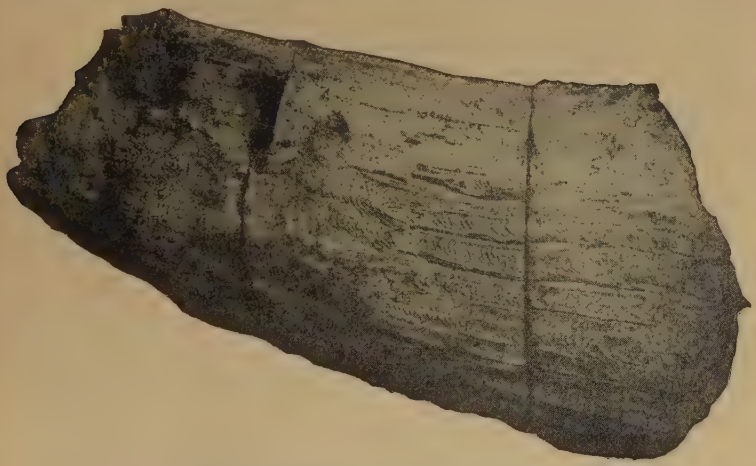

FIG. 4. An "index fossil," *Sauvagesia degolgeri* (Stanton), recently discovered in the Tampico region, Mexico. Dr. T. W. Stanton says of it, that it "establishes the Cretaceous age of the San Felipe formation in its typical exposures west of Tampico." ("A New Cretaceous Rudistid," "Proceedings of the United States National Museum," Vol. 59, p. 453.)

expert paleontologist, who will tell him the exact "age" of the rocks from which they were taken, providing these fossils happen to be what are regarded as typical or safe "guide" fossils, or "index" fossils.

Not all fossils are regarded as suitable for thus determining the age of a set of beds. Multitudes of fossils are considered as ambiguous, because they are found to occur in many different formations. And

where none but these indeterminate fossils can be found, geologists have to rely as best they can upon other criteria, such as stratigraphy, or the lithologic characters, to make a correlation of these beds with the other standard formations from elsewhere, and await the discovery of more conclusive fossil evidence. But whenever certain representative trilobites, or brachiopods, or graptolites, or belemnites, or ammonites, or what not, are found in the rocks, no geologist or paleontologist would have the slightest hesitation in assigning these rocks to a very definite place in the long geological succession, *no matter what the beds might look like, and no matter what other kinds of strata were found occurring either above or below.*

That the fossils are in reality the sole test of the "age" of the rocks in which they are found, will appear from the following quotations, which are typical of many more that might be given. Grabau tells us:

> "The primary divisions of the geologic time scale are, as we have seen, based on the changes in life, with the result that fossils alone determine whether a formation belongs to one or the other of these great divisions."[5]

H. S. Williams tells us the same thing, with even more details in the statement:

> "These systems [Quarternary, Tertiary, Cretaceous, etc.], although actually arbitrary groupings of the stratified rocks of particular regions, have come into use as the primary divisions of the rocks whenever chronological sequence is considered. In describing any newly discovered fossiliferous strata

[5] "Principles of Stratigraphy," p. 1103.

in any part of the earth, the first step to be taken, in giving them a scientific definition, is to assign them to one or other of these systems upon evidence of the fossils found in them. The character of the rocks themselves, their composition, or their mineral contents have nothing to do with settling the question as to the particular system to which the new rocks belong. The fossils alone are the means of correlation.''[6]

III

Our object now is to decide whether this method of determining the age of a newly found set of rocks, that is, the method of assigning these rocks to a definite place in a system of world-chronology, is in all respects a scientific one, conformable in all essential respects to the methods followed in the other sciences, such as physics, chemistry, or astronomy. If we are *already sure* that there has been a succession of life on the globe, and if we are *already certain* of just which types of life existed at certain periods, and can be absolutely sure that other types of life were *not* then in existence, we may feel confident regarding the geological age of a newly discovered rock deposit by comparing its fossils with those of this series as already determined. But how did geologists *first* determine this order of successive life-forms? Or how can we now prove in logical, scientific fashion, that there has actually been this succession of life on the globe in a particular order? In other words, *how did geologists first construct their elaborate index?* To illustrate the matter further, how are we to prove that when the Cambrian forms were existing in one locality, let us say New York, this assemblage of ani-

[6] ''Geological Biology,'' pp. 37, 38.

mals and seaweeds really prevailed everywhere on earth, or at least that no other higher types, such as dinosaurs, or elephants, or men, were then in existence anywhere else, perhaps on the other side of the globe?

During the last two or three generations, probably thousands of students have asked themselves these questions. Sometimes they have ventured to ask their instructors; but they have usually been told that the founders of the science "have ascertained" that certain fossils occur only in certain rocks; and what can this possibly mean except that certain kinds of life lived only in a certain age of the world's history, that these were in turn succeeded by others, and so on to the end of the list?

But is this the only possible explanation? Pretty slim data, one would think, on which to build so large and momentous a conclusion. Is the student of chemistry, or physics, or astronomy told that the basic facts and principles of his science have been worked out long ago by the founders of the science, but that these foundation principles are too recondite and too difficult to be explained to beginners? At any rate, should not the student in geology be directed to the definite persons, to the particular time and place, when these foundation principles of the geological succession of life were first worked out and logically established?

But let us examine this supposition that only certain types of life were living in a certain geological age.

At the present time, in our modern lakes, seas, and oceans, samples of every grade of life are being buried for fossilization in different localities,—worms, mollusks, crustaceans, insects, reptiles, amphibians, fishes, mammals, and human beings, all are now becoming candidates for fossilization. As we proceed backwards in time, how are we to know when we arrive at a time in the past when this principle would not hold good? In other words, if we hold strictly to scientific methods, *how can we ever get back of the time* when all these forms with which we are now acquainted were living together contemporaneously? How can we, except by dogmatically assuming a supernatural knowledge of the past, fix on a time when *only a very limited few* of the lower forms existed on the globe? The current geological theories say that there was such a time; and the whole science as now commonly taught, indeed the whole scheme of organic evolution, rests on the supposition that such was the case. But how are we to prove such a statement in strict scientific fashion? Or how can we justify this idea as to its details without assuming the very thing that we are trying to prove?

To some, it may seem like a very extravagant statement for me to say that in the whole field of scientific study there is to-day nothing of such tremendous importance and far-reaching consequences as is the definite determination of this very point: Are these successive ages, or the successive groups of life in a definite order, as pictured by the current geology, actual scientific *fact,* or are they mere evolu-

tionary *assumption?* Can these distinct successive ages be proved objectively, or must we confess that their existence is a mere speculation, quite incapable of objective proof? However, when we realize that all the alleged chronological relationships between the different groups of fossils are absolutely dependent upon this idea and that the whole scheme of organic evolution, with all that has been built upon it, is built up logically around this geological concept of successive types of life, my statement of the vast importance of this problem will appear natural and reasonable. It is the most important and the most far-reaching problem before the scientific world to-day; and we shall do well to examine it with the utmost care and thoroughness.

The present writer has examined all the literature of geology and paleontology published during the past century or so, which deals with the problem we are here considering. This portion of geological and paleontological literature is very scanty, either because the leaders in these sciences have given little attention to the basic ideas of this problem, or because, after thinking about it, they did not know what to say regarding it. Only four authors that I have been able to find,—Spencer, Huxley, Nicholson, and Suess, with possibly one or two others that I may have missed,—have written anything of importance or have attempted to sound the logical bottom of this problem. It will be convenient to consider what each of these four representative men has said upon this subject.

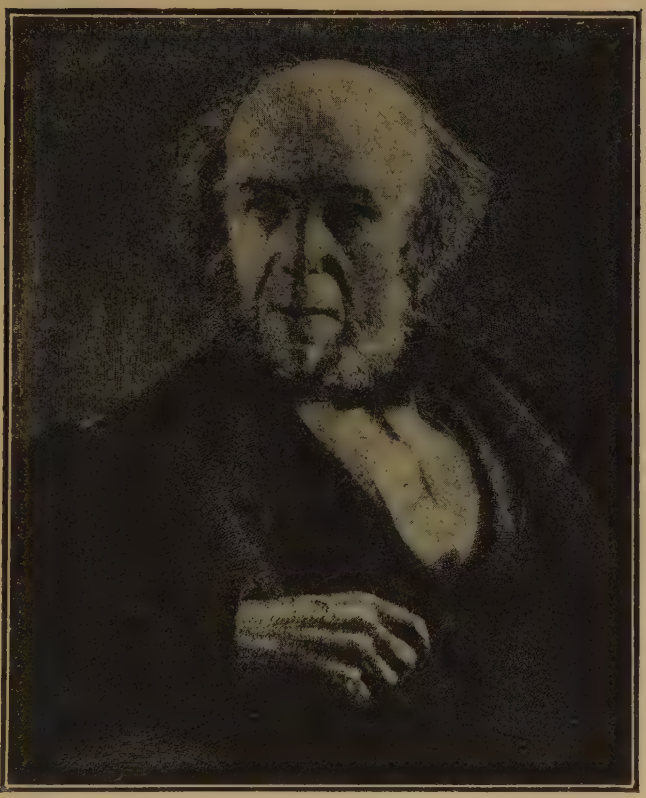

FIG. 5. Herbert Spencer (1820-1903), one of the first teachers of the theory of evolution.

IV

Herbert Spencer, in his early essay on "Illogical Geology,"[1] did not seem to think that the way in which Lyell and his followers had built up their main doctrine of an orderly succession of various types of

[1] "Illustrations of Universal Progress," pp. 329-380, New York, 1890.

life was a praiseworthy example of the methods to be pursued in natural science.

He starts out with Werner, of Neptunian fame, and shows that the latter's main idea of the rocks always succeeding one another over the whole globe, like the coats of an onion, was "untenable if analyzed," and "physically absurd"; for among other things, it is incomprehensible that these very different kinds of rocks could have been precipitated one after another by the same "chaotic menstruum."

Werner had taken for his data the way in which the rocks happened to occur in "a narrow district of Germany," and had at once jumped to the conclusion that they must always occur in this relative order over the entire globe. "Thus, on a very incomplete acquaintance with a thousandth part of the earth's crust, he based a sweeping generalization applying to the whole of it."

Werner classified the rocks according to their mineral characters; but when the fossils were taken as the prime test of age, the "original nomenclature of periods and formations," says Spencer, kept alive the original idea of complete envelopes encircling the whole globe one outside another like the coats of an onion. So that now, instead of Werner's successive ages of sandstone making or limestone making, and successive suites of these rocks, we have successive ages of various types of life, with successive systems or "groups of formations which everywhere succeed each other in a given order, and are severally everywhere of the same age. Though it may not be as-

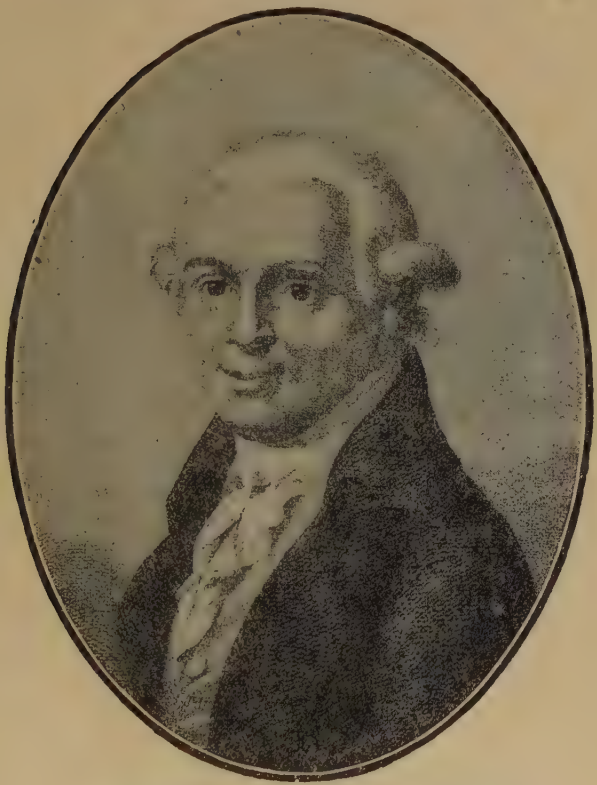

FIG. 6. A. G. Werner (1749-1817), the originator or promulgator of the "onion-coat" theory.

serted that these successive systems are *universal,* yet it seems to be tacitly *assumed that they are so.* . . . Though, probably, no competent geologist would contend that the European classification of strata is applicable to the globe as a whole, yet most, if not all geologists, *write as though it were so.*'"

[8] Page 332. [9] Page 339.

Spencer then goes on to show how dogmatic and unscientific it is to say that when the Carboniferous flora, for example, existed in some localities, *this type of life and this only must have enveloped the world.*

"Now this belief," he says, "that geologic 'systems' are universal, is quite as untenable as the other. It is just as absurd when considered *a priori;* and it is equally inconsistent with the facts,"[10] for all such systems of similar life-forms must in olden time have been of merely *"local origin,"* just as they are now. *In other words, it is folly to claim to have a scientific knowledge of a time in the remote past when there were not floral and faunal provinces and districts, as there are to-day, one type of life existing in one locality, while other and totally different kinds existed somewhere else.* Though Spencer does not go thus far, it evidently implies a supernatural knowledge of the past to affirm, as the life-succession theory does, that such unnatural conditions ever prevailed. But the merest tyro in logic can see that the whole scheme of organic evolution is moonshine, if we find out that these various groups of fossils, now supposed to have been successive or in a true historical series, were really contemporaneous with one another after all.

In the world to-day, *the only world which can serve us as a reliable guide in things scientific,* we continually find radically distinct faunas living side by side, only a few miles apart. The fauna to the north of Cape Cod is quite different from that to the south of the same spot; the Red Sea fauna was dif-

[10] Page 340.

ferent from that of the Mediterranean, until the two began to commingle, by the digging of the Suez Canal. Two very distinct faunas coexist on the opposite sides of the Isthmus of Panama.

Spencer gives some examples of this sort, though he does not say, as he might well have said, that Cambrian trilobites may have been strictly contemporary with Cretaceous ammonites and dinosaurs; that the Carboniferous flora may have coexisted only a comparatively few miles away from the Miocene flora, or that the Mesozoic dinosaurs may have lived in certain localities, while the mastodons and megatheriums and mammoths and saber-tooth tigers were also roaming the plains not a hundred miles away.

However, after quoting from Lyell a strong protest against the older form of the onion-coat theory, under which it was taught that only certain kinds of sandstone and marl and shale were made at certain epochs, Spencer proceeds thus:

"Nevertheless, while in this and numerous passages of like implication, Sir C. Lyell protests against the bias here illustrated, he seems himself not completely free from it. Though he utterly rejects the old hypothesis that all over the earth the same continuous strata lie upon each other in regular order, like the coats of an onion, he still writes as though geologic 'systems' do thus succeed each other. A reader of his 'Manual' would certainly suppose him to believe that the Primary epoch ended, and the Secondary epoch commenced, all over the world at the same time. . . . *Must we not say that though the onion-coat hypothesis is dead, its spirit is traceable, under a transcendental form, even in the conclusions of its antagonists?*"[11]

[11] Pages 342, 343.

The conclusion thus rather timidly put forward is absolutely unavoidable. For if we are ashamed of this modern form of the onion-coat theory — namely, that fossiliferous groups of life were successively universal over the globe — we can only disclaim it by admitting in full the alternative of geographical provinces and districts, or, in other words, admitting that very diverse types were living contemporaneously in the oldest period of which we have scientific knowledge, just as we find them doing to-day. And then, how are we to *set limits* to the possible diversity of these contemporary forms in that early time, that morning of the world? But the current system of geology *denies that very diverse types could have been living contemporaneously in the long ago;* hence we must own that we have this modern form of the onion-coat theory, a real biological onion-coat theory, still taught as science in practically every college and university throughout the civilized world.

Spencer then examines at considerable length the kindred idea that the same or similar species "lived in all parts of the earth at the same time." "This theory," he says, "is scarcely more tenable than the other."[12]

He shows how, in some localities, there are now forming coral deposits, in some places chalk, and in others beds of mollusks; while in still other places, entirely different forms of life are existing. In fact, each zone or depth of the ocean has its particular type of life, just as successive altitudes have on the

[12] Page 343.

sides of a mountain; and it is a dogmatic and arbitrary assumption to say that such conditions have *not* existed in the past, or to limit in any way the diverse varieties of life that may then have coexisted in widely separated localities.

"On our own coasts, the marine remains found a few miles from shore, in banks where fish congregate, are different from those found close to the shore, where only littoral species flourish. . . . Were it not that the assertion seems needful, it would be almost absurd to say that the organic remains now being buried in the Dogger Bank can tell us next to nothing about the fish, crustaceans, mollusks, and corals that are now being buried in the Bay of Bengal."[13]

Herbert Spencer entitled his essay, "Illogical Geology," and he evidently had difficulty to keep within the bounds of parliamentary language when speaking of the absurd and vicious reasoning at the very basis of the whole current geological theory; for, unlike the other physical sciences, the great leading ideas of geology, such as uniformity, the succession of life, etc., are *not* generalizations framed from the whole series or group of observed facts, but are really dogmatic statements supposed to be axiomatic, or at the most *very hasty conclusions based on wholly insufficient data,* like that of Werner in his "narrow district of Germany." Sir Henry Howorth[14] has well expressed the urgent need there is of a complete reconstruction of geological theory:

"It is a singular and a notable fact, that while most other branches of science have emancipated themselves from the

[13] Page 353.
[14] "The Glacial Nightmare and the Flood," Preface 7.

trammels of metaphysical reasoning, the science of geology still remains imprisoned in *a priori* theories.''

V

But Huxley also has left us some remarks along the same line, which are almost equally helpful in showing the essential absurdity of the assumption that when one type of life was living and being buried in one locality, another and very diverse type could *not* have been flourishing in other distant localities,—in other words, the absurdity of this modern onion-coat theory.

This is how he expresses it:

''All competent authorities will probably assent to the proposition that physical geology does not enable us in any way to reply to this question: Were the British Cretaceous rocks deposited at the same time as those of India, or were they a million of years younger, or a million of years older?''[15]

''*All that geology can prove is local order of succession.* It is mathematically certain that, in any given vertical linear section of an undisturbed series of sedimentary deposits, the bed which lies lowest is the *oldest*. . . . For areas of moderate extent, it is doubtless true that no practical evil is likely to result from assuming the corresponding beds to be synchronous or strictly contemporaneous; and there are multitudes of accessory circumstances which may fully justify the assumption of such synchrony. *But the moment the geologist has to deal with large areas,* or with *completely* separated deposits, the mischief of confounding that 'homotaxis' or similarity of arrangement which *can* be demonstrated, with 'synchrony' or identity of date *for which there is not a shadow of proof,* under the one common term of 'contemporaneity,' becomes incalculable, and proves the constant source of gratuitous speculations.''[16]

[15] ''Lectures and Lay Sermons,'' ed. 1913; p. 27.
[16] Pages 29, 30.

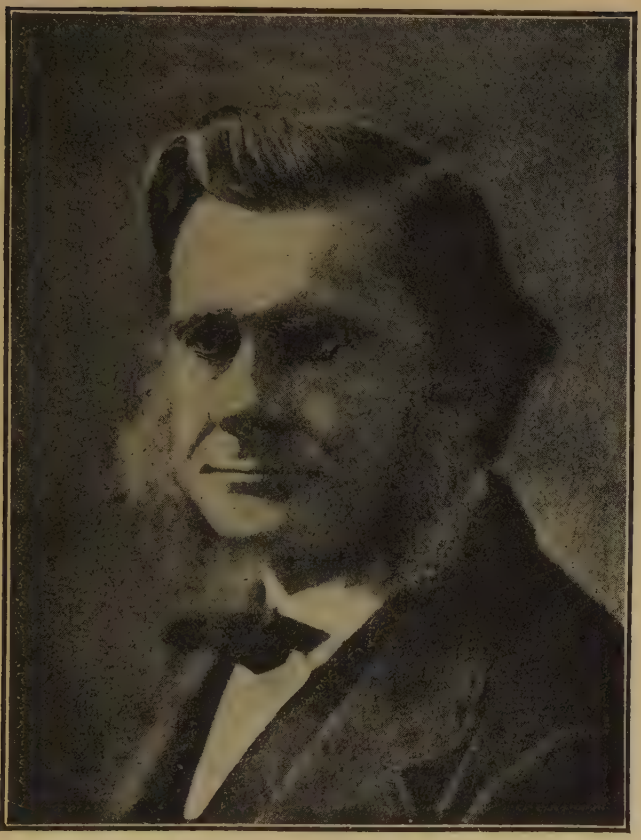

FIG. 7. Thomas Henry Huxley (1825-1895), ardent advocate of the theory of organic evolution.

Yet even so clear a thinker as Huxley usually was, does not seem to have had more than a twilight vision of the real questions involved in this modern onion-coat theory. For it is not a question of whether the British Cretaceous fossils lived contemporane-

ously with the Cretaceous of India. No doubt they did; for the human mind instinctively believes that representatives of the same types of life, no matter how distant geographically, must have been connected in time and must have been related to one another by descent. But it is really the converse of this proposition that needs to be critically examined; namely, the assumed denial that *very dissimilar* forms in England or India or America were also contemporaneous. Could not the trilobites and the ammonites have lived contemporaneously in the same ocean? And might not the dinosaurs and the titanotheres and mastodons also have been living (in separated localities) on the lands at the very same time? The new geology says that they were thus contemporary, while the evolutionary theory of successive ages denies it; for it is useless to talk about distinct geological ages, if dissimilar types were contemporary in the long ago as they are to-day.

Huxley, indeed, seems to have caught a glimpse of the absurdity of denying that there must have been zoölogical provinces in the long ago, for he says:

"A Devonian fauna and flora in the British Islands *may* have been contemporaneous with Silurian life in North America, and with a Carboniferous fauna and flora in Africa. *Geographical provinces and zones may have been as distinctly marked in the Paleozoic epoch as at present.*"[17]

Certainly; but if this be true, it is equally certain that the Carboniferous flora of Pennsylvania may have been contemporaneous alike with the Cretaceous

[17] Page 30.

flora of British Columbia and the Tertiary flora of Germany and Australia. *But in that case, what becomes of this succession of life* which for nearly a century has been the pole-star of all the other biological sciences — I might almost say, of the historical and theological as well?

What if the Mammoth, the Mastodon, and the Megatherium were really contemporary with the still more gigantic Brontosaurus, the Diplodocus, and the Brachiosaurus? What if the ichthyosaurs, the plesiosaurs, and the mosasaurs swam around in the same seas in which lived the trilobites, the ammonites, and the nummulites? Personally, I do not see anything strange in such a suggestion. But if some one denies all this, how is he to *prove* the impossibility of such contemporaneity? I think I am fairly familiar with the facts regarding how all these creatures occur as fossils. I am also familiar with most of the literature of the science, both that of my contemporaries and that of two and three generations ago. And yet I must confess that if some of my friends were to undertake to defend the thesis that these animals could not have lived contemporaneously, he would have to put up a good deal better argument than any arguments along this line with which I am acquainted.

Must it not be admitted that, in any system of clear thinking, this whole idea of there having really been a time when only a certain *limited number* of life-forms were in existence, and these more or less universally distributed over the whole globe, is not only *not proved* by scientific methods, but is essen-

tially unprovable, quite outside the limits of natural science?

Huxley, in point of fact, admits this, though he goes right on with his scheme of evolution, just as if he never thought of the logical consequences involved.

"In the present condition of our knowledge and of our methods [*sic*] one verdict—*'Not proven and not provable'*—must be recorded against all the grand hypotheses of the paleontologist respecting the general succession of life on the globe."[18]

These remarks of Huxley's indeed, were so near to the whole truth of the matter, that it almost seemed as if geology would follow the example of the other sciences by emancipating itself from the trammels of metaphysical speculation, and donning the garb of demonstrated fact. But it appears that his criticisms only served to awaken the theorizers long enough to use this new light about zoölogical provinces and districts to help them out of some minor puzzles into which their theory had led them; for outside of a few admiring references to this idea of "homotaxis," subsequent writers have seen in them nothing suggestive of the miserable logic on which the whole theory of successive ages, and thus the evolution doctrine also, has been built up.

VI

Prof. H. Alleyne Nicholson[19] is almost the only other writer who has considered it worth while to try to defend this doctrine of successive ages; and we

[18] Ibid.

[19] "Manual of Paleontology," General Introduction, 3d ed., pp. 47, 52.

must next note some of his remarks illustrating how near this idea of projecting our modern conditions of geographical distribution back into the past came to wrecking the inherited onion-coat theory, the spirit of which, Spencer says, is still traceable, "under a transcendental form, even in the conclusions of its antagonists."

"When it had been clearly established," says Nicholson, "that particular groups of strata in Europe were characterized by particular assemblages of animals and plants, it was, not unnaturally, concluded that similar or identical assemblages of organisms would be found to characterize corresponding groups of strata all over the world. This led to the idea that the successive faunæ and floræ observable in the area first examined had been *universally distributed over the whole globe* [that is, the onion-coat theory was still retained]; from which followed the old catastrophic view that the close of each geological period had been signalized by a more or less complete extinction of the animals and plants then in existence, and that a new fauna and flora had been introduced at the commencement of each succeeding period."

He continues:

"It is, however, now universally admitted that in nature the chronological succession of rocks, as determined by fossil remains, *is local and not universal,* in the sense that the precise order of phenomena must necessarily have differed in different regions. That this must be so is proved by the existence at the present day of 'zoölogical provinces'; by the fact that dry land and sea must always have existed since the beginning of Paleozoic time at any rate, and that sedi-

mentation can, therefore, never have been universal; and by the certainty that the sedimentary deposits now in process of formation, and therefore necessarily coeval, contain the remains of *dissimilar* groups of animals and plants."

Page after page is devoted by this author to enlarging on this principle of true science, which teaches us that dissimilar groups of life are now coexisting in separate localities, and that if we hold fast to real experience, and project our modern conditions of geographical distribution back into the past until we find positive evidence of the contrary, *we can not attain to any scientific knowledge of a time when this principle ought not to hold good.* But it is surely one of the most amazing things in the whole history of natural science to see how neither Nicholson, nor Huxley, nor Spencer, nor any of their thousands of followers, have realized how completely this principle removes the whole foundation on which rests the idea of relative time-value, which still persists in assuring us that when a Carboniferous group was existing here, a Cambrian group could not have been existing over there, and Cretaceous and Tertiary groups somewhere else. That an assumption of such a supernatural knowledge of the past, totally at variance with our modern knowledge of plant and animal distribution, still flaunts itself in our eyes from every textbook professing to deal with the earth's early history, is an anachronism almost passing belief. Some day, when this science is reconstructed by being built up on inductive principles from the present instead of being postulated from the past, this part

of the history of natural science will make a most amazing story for our posterity.

VII

"The Face of the Earth,"[20] by Eduard Suess, of Vienna, is acknowledged by all to indicate the high-water mark of geological literature. In that work, several references are made to the problem of what these geological classifications really mean; and finally the author leaves it unsolved, as one of the largest tasks he must bequeath to the next generation of investigators.

Three or four times he alludes to "the remarkable fact that it has been found possible to employ the same terminology to distinguish the sedimentary formations in all parts of the world."[21] But it is quite obvious that this is only the modern aspect of the onion-coat theory in what Spencer calls its "transcendental" form; and it is equally obvious that, if we look upon the geological series of life-forms as having no intrinsic time-value whatever, but as being only an old-time taxonomic series of that ancient world, as will appear later, this "remarkable fact," which seems such a puzzle to this accomplished scientist, becomes as clear as sunlight, and immediately falls into its natural place in a scheme of true inductive geology.

In his picturesque way, Suess puts one of the characteristic features of this modern onion-coat theory in the form of a question, as to how the

[20] Oxford, 1904-1909.
[21] Vol. 2, p. 540.

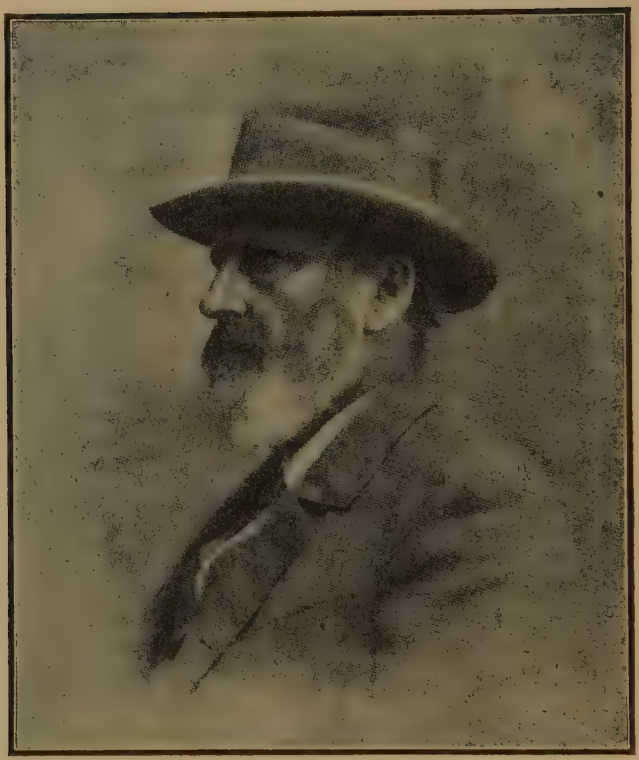

FIG. 8. Eduard Suess (1831-1914), celebrated Austrian geologist; author of *Das Antlitz der Erde* ("The Face of the Earth," Oxford University Press, 1904-1908). Professor Suess during his life was one of the very foremost of modern geologists.

Silurian formation, one of "the very earliest of them all," "recurs in parts of the earth so widely removed from one another — from Lake Ladoga to the Argentine Andes, and from Arctic America to Australia — always attended by such characteristic features," and how it happens "that particular

horizons of various ages may be compared to or distinguished from other horizons over such large areas, that in fact these stratigraphical subdivisions extend over the whole globe."[22]

Two illustrative examples of what Suess here refers to may be given. The graptolites are among the most characteristic fossils of the Ordovician;[23] and they are minutely graded off, each particular type serving as the index fossils for one of the various zones. And "graptolite zones, with the same or closely similar species, and in the same order of succession, are found in Great Britain, the St. Lawrence and Champlain valleys, and in Australia."[24]

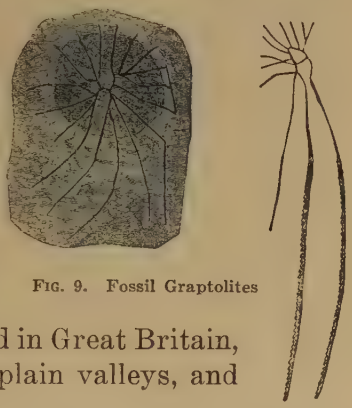

FIG. 9. Fossil Graptolites

Regarding the divisions of the Jurassic, we have also the following from the author just quoted:

"Even the minuter divisions, the substages and zones of the European Jura, are applicable to the classification of the South American beds."[25]

It is this ghost of the onion-coat theory which disturbs the banqueting of our modern geologists, to which Professor Suess alludes in the above-mentioned quotation, and which he mentions repeatedly throughout these four remarkable volumes.

[22] Vol. 1, p. 8.
[23] Lower Silurian of Europe.
[24] W. B. Scott, "Introduction," p. 572.
[25] Pages 681, 682.

As already remarked, Professor Suess considers that this fact, that even the minutest subdivisions of the geological series extend over the whole globe, is one of the great unsolved problems of the science; for he says that "if we could assemble in one brilliant tribunal the most famous masters of our science, and could lay this question of the student before them, I doubt whether the reply would be unanimous, I do not even know if it would be definite."[26]

Of course, from the standpoint of current theory, this question must ever remain without explanation; for the one thought pervading this whole work of Professor Suess is that absolutely nothing in the direction of an exchange of ocean and dry land is now going on, and thus we have no modern analogies to explain how those great universal "transgressions" of the ocean took place in the past. In other words, uniformitarianism is now found to be bankrupt as an explanation of the past geological changes. But how simple this problem becomes, how natural this whole phenomenon appears, when we look upon the geological series as only an old-time taxonomic, or classification, series, artificially arranged, of the various floras and faunas of the ancient world, all of which, however, may have lived contemporaneously with one another!

As this explanation never had occurred to him, Professor Suess concludes his discussion of this subject with the very explicit statement that if an inquiring student were to seek an answer to this

[26] Ibid.

problem in his "Face of the Earth," "he would not find in it an answer to his question."[27] In other words, the most accomplished and most philosophical geologist of modern times has no explanation of why this "transcendental form" of the old onion-coat theory *works so well* when applied to the classification of the fossils from all parts of the world.

But why should not an ancient taxonomic, or classification, series work as well as a modern one? All the geological formations, and all the subdivisions of the geological series, little and big, are merely old-time taxonomic divisions, with geographical names attached. They are based not on stratigraphy (except locally), but wholly on taxonomic considerations; and why should not a taxonomic series, *if all are agreed to follow it,* be just as applicable to Australia, or Peru, or Alaska, or Florida, or England, or Germany, as here in the United States,—provided, of course, we happen to find specimens with which to illustrate it?

This is all there really is to Professor Suess's wonderful conundrum; and it is astonishing that he and others can not see it.

But if this be true, there is nothing left of the geological succession of the fossils, except a purely artificial arrangement, valuable as a working classification, a tool for convenient study, but with absolutely no other scientific value whatever. That the parts of this series have relative time-values in and of themselves, is grotesque in its want of logic. No clear thinker would ever dream of such a thing, if

[27] Vol. 1, p. 15.

this idea were not now given an artificial life through the accumulated momentum of a hundred years of use and scientific prestige. That this idea can longer continue to be reverentially respected and actually used as the basis for constructing evolutionary trees of descent for the various animals and plants, is a sad example of mental inertia, and of the difficulty of dislodging a venerable falsehood even from the minds of scientifically trained people.

VIII

It may be worth while to gather into concise form the facts we have learned thus far:

1. The geological ages depend wholly upon the types of life supposed to have flourished at these various periods; and the age of a rock is determined by its contained or associated fossils.

2. Spencer not only saw the absurdity of Werner's onion-coat theory, but he blames Lyell and the other modern geologists for still perpetuating the absurd idea that the geological formations are universal over the globe, and says that we now have onion-coats of fossiliferous rocks, instead of the old mineral onion-coats of Werner.

3. Huxley acknowledges that geology can prove nothing more than local order of succession; that when we come to deal with large areas, there is "not a shadow of proof" for saying that one type of rock in England was or was not formed at the same time as other rocks in America or Africa; and that all the paleontological notions about the general

succession of life on the globe are "not proven and not provable."

4. Nicholson, and indeed all modern geologists, seem quite ashamed of the onion-coat theory of Werner; and they try to prove themselves clear of it by speaking rather timidly of the principle of zoölogical provinces and districts, partially admitting that dissimilar groups of life must have existed contemporaneously in the olden time as now—*how dissimilar, they dare not say,* because to admit this principle fully, must forever destroy the idea of successive ages of life. For if we renounce entirely this modern form of the onion-coat theory, must we not admit that mammals may have lived on the land while trilobites were living in the sea, or that nummulites may have been contemporary with the graptolites, or oaks, beeches, and birches contemporary with the lepidodendrons and sigillaria? And then what will become of the theory of successive ages?

5. Professor Suess seems dazed at the universal spread not only of the larger groups or systems, but also of the particular horizons or stratigraphical subdivisions; and he remarks with astonishment that it has been found possible "to employ the same terminology to distinguish the sedimentary formations in all parts of the world." He feels very doubtful whether, if all the masters of the science were assembled together and this problem were propounded to them, the reply would be unanimous, or even "definite." As for himself, he has no explanation.

6. From all this discussion, it follows that the distinctions in regard to age which are made between the various fossil animals and plants, are not scientifically established, and have no scientific value. A fossil is not necessarily old because it has been found in a Cambrian bed; nor is one necessarily young because it occurs in a Cretaceous or a Tertiary. In other words, the Cambrian fossils may not be a day older than others from a distant locality classed as Tertiary or Pleistocene. The common-sense distinctions in age are still left us, and may be applied with confidence in any specific locality, based on stratigraphy alone, but we must abandon any world-scheme which would try to make certain fossils to be always and necessarily older than others. The latter is a pseudo-scientific idea, with no support in actual fact.

On the other hand, what geology has been dealing with all these years under the name of a "phylogenic" series, turns out to be nothing but an old-time taxonomic series, buried somehow, and at some time or times, which must be determined later and by other considerations. But there is absolutely nothing in the geological record to forbid our believing that all these various types of life were really once living contemporaneously together in an older state of our world. How long ago they lived, or how they were buried, are questions which we are not yet prepared to solve. There are many other facts which we need to consider first. For here we have been studying only the abstract idea of the geological succession. And we find that geologists have in reality been tak-

ing the taxonomic series of an older state of our world, and have been thinking that they saw in this taxonomic series a true historical succession.

It is as if a man were to find an immense library, and were to insist that all the books listed under A, B, and C were really printed long before those listed under X, Y, and Z; and as if he were to support this idea by carefully showing how all the A books were published simultaneously in London, Chicago, Atlanta, San Francisco, and even in Paris, Berlin, and in Sydney, Australia; and so on all through the list. And then he expressed a wonder how it happened that the publishers in all these scattered localities had each hit upon the same idea at the same time as the others, and all had thus issued books alike.

How long would such a theory pass among educated men as being strictly scientific?

So much, then, for the *a priori* argument. We must now look at the history of the idea, and in subsequent chapters consider the stratigraphical features of the theory.

CHAPTER II

History of the Idea

I

Among the few stray principles which the future will probably be able to save from the wreck of Spencer's philosophy, is the advisability of looking into *the genealogy of an idea.* What have been its surroundings? What is its family history? Does it come of good stock, or is its family low and not very respectable?

This is especially true in the case of a scientific idea, which above all others needs to have a clean bill of health and a good family record. But, unfortunately, the idea we are here considering has a bad record—very bad, in fact; for the whole family of Cosmogonies, of which this notion is the only surviving representative, were supposed to have been banished from the land of science long ago, and were all reported dead. Some of them had to be executed by popular ridicule, but most of them died a natural death, the result of inherited taint, in the latter part of the eighteenth and the early nineteenth century. It is perfectly astonishing how any of the family could have survived over into the twentieth century, in the face of such an antecedent record.

For one of the chief traits of the family as a whole is that of mental disorder of various stages

and degrees. Some of them were raving crazy; others were mild and comparatively harmless, except that their imbecility had so disturbing an effect on scientific investigations that they had to be put out of the way. It seems such a pity that when this last fellow, early in life, was up before Doctors Huxley, Spencer, and others, for examination, he was not locked up or put in limbo forthwith. This is especially unfortunate, because this survivor of an otherwise extinct race has since produced a large family, some of which, it is true, have already expired, while the eldest son, Darwinism, was reported some time ago to be "at its last gasp,"[1] and was even said to have had its "tombstone inscription" written a few years ago by Von Hartmann of Germany. But the succession-of-life idea itself, the father of all this brood, is still certified by those in authority to be healthy and *compos mentis*.

II

The Cosmogony family is a very ancient one, running back to the time of Plato and Thales of Miletus. Indeed, the cuneiform inscriptions of Babylonia seem to indicate that a tribe with very similar characteristics existed several millenniums before the Christian era. But discarding all these, the first men that we need to mention are perhaps Burnet and Whiston, who knew no other way of arriving at geological truth than to spin a yarn about how the world was made. Woodward (1665-1722) seems to have been wiser, and

[1] *Nature*, Nov. 28, 1901, pp. 76, 77.

is named along with Hooke and John Ray as one of the real founders of geology.

Unfortunately, the brood of Cosmogonists was not dead, for Moro and De Maillet were at this same period spinning their fantastic theories about the origin of things; or, as Zittel puts it, "accepted the risks of error, and set about explaining the past and present *from the subjective standpoint.*"[2] This tendency we shall find to be a birthmark in the family, and it will serve invariably to identify any of them wherever found. We must remember this, and apply the test to the modern survivors.

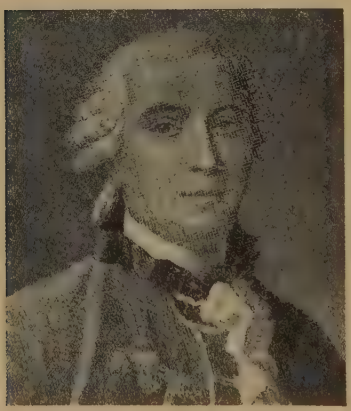

FIG. 10. Count de Buffon 1707-1788

Buffon (1707-1788), "whose genius, unballasted by an adequate knowledge of facts, often played him sad tricks,"[3] seems to have been really the founder of the family in modern form. He is credited with the sarcastic remark that "geologists must feel like the ancient Roman augurs who could not meet each other without laughing"; though in view of his fantastic scheme of seven "epochs," in which he endeavors to portray "the beginning, the past, and the future (*sic*) of our planet,"[4]

[2] "History of Geology," p. 23.

[3] Hartog.

[4] Zittel, p. 42.

one is reminded of the common symptom which manifests itself in thinking all the rest of the world crazy.

The "Heroic Age of Geology" succeeded this period, and was characterized largely by a determination to discard speculation, and to seek to build up a true science of actual fact and truth.

We have already seen, from Spencer's remarks, that A. G. Werner (1749-1817), who was, however, one of the leaders in Germany at this time, was very far from following true inductive methods. And the following language of Sir Archibald Geikie shows that in him the family characteristics were decidedly prominent:

"But never in the history of science did a stranger hallucination arise than that of Werner and his school, when they supposed themselves to discard theory and build on a foundation of accurately ascertained fact. Never was a system devised in which theory was more rampant; theory, too, unsupported by observation, and, as we now know, utterly erroneous. From beginning to end of Werner's method and its application, assumptions were made for which there was no ground, and these assumptions were treated as demonstrable facts. *The very point to be proved was taken for granted,* and the geognosts, who boasted of their avoidance of speculation, were in reality among the most hopelessly speculative of all the generations that had tried to solve the problem of the theory of the earth."[5]

In fact, this author says that "the Wernerians were as certain of the origin and sequence of the rocks as if they had been present at the formation of the earth's crust."[6]

[5] "Founders of Geology," p. 112, Johns Hopkins Press, 1901.
[6] Pages 288, 289.

Here we see the family characteristics very strongly developed.

III

In speaking of Werner's five successive "suites" or onion-coats in which he wrapped his embryo world, Zittel complains:

> "Unfortunately, Werner's field observations were *limited to a small district,* the Erz Mountains and the neighboring parts of Saxony and Bohemia. And his chronological scheme of formations was founded upon the mode of occurrence of the rocks within these narrow confines."[1]

Yet, as we have seen, it is precisely such a charge as this that Spencer and Huxley bring against the modern phase of the doctrine of successive ages based on the succession-of-life idea. Werner, from observations "limited to a small district," constructed his scheme of exact chronological sequence for the rest of the world, basing it entirely upon the mineral or mechanical character of his "suites." And hundreds of enthusiastic followers long declared that the rocks everywhere conformed to this classification. Even so great an observer as Von Humboldt thought that the rocks which he examined in Central and South America fully confirmed Werner's chronological arrangement.

But such notions to-day only cause a smile of pity, for it is now well known that, take the world over, the rocks do *not* occur as Werner imagined, though, as Geikie says, he and his disciples were as certain of the matter "as if they had been present

[1] "History of Geology and Paleontology," p. 59.

at the formation of the earth's crust." Indeed, we now know that, as Lyell tells us, "the Saxon professor had misrepresented many of the most important appearances even in the immediate neighborhood of Freyberg," his home. Within a day's journey of his school, the rocks have since been found in several instances in an order of relationship utterly contrary to his teachings.[8]

Besides, as already pointed out, we in modern times have now pretty well assimilated the idea that while one kind of mineral or rock was forming in one locality, a totally different kind of deposit may have been in process of formation in another spot some distance off, *at the very same time;* and there is no scientific way of getting back to a time in the past when this principle would not hold good. And yet, when this crude mineral onion-coat theory was proved to be absurd, the very same idea of a time-value was, as we shall see, transferred from the mechanical and mineral character of the rocks to their fossil contents; which is a much more subtle idea, but still an idea of *exactly the same order.* And from observations again "limited to a small district," William Smith and Cuvier conceived the idea that the fossils occurred *only* in a certain order, that only certain fossils lived at a certain time — that, for example, while trilobites were living and dying in one locality, nummulites or mammals positively were *not* living and dying in another locality — though in any system of clear thinking, this latter notion is just as unscientific as that of Werner.

[8] "Principles," Lyell, 8th ed., p. 49.

In short, this new system of identifying rocks by their fossils still retained the whole essential absurdity of the onion-coat theory, namely, the *universality* of one kind of deposit; it merely restated this theory in terms of the fossils, instead of in terms of mineralogy and mechanical texture. It involved all the arbitrary assumptions, all the incredible fictions about unnatural past conditions that characterized the theory of Werner, which it professed to displace; and though all modern scientists profess to have outgrown these crudities, they have never made a clean job of eliminating the characteristic absurdity of the whole system, namely, *the universality, in the long ago, of one limited assemblage of life-forms.* Hence Spencer is compelled to say, "Though the onion-coat hypothesis is dead, its spirit is traceable, under a transcendental form, even in the conclusions of its antagonists."[9]

The two cases are exactly parallel; only it has taken us nearly a hundred years, it seems, to find out that the fossils do not follow the prearranged order of Smith and Cuvier any better than the rocks and the minerals follow the scheme of Werner. If hundreds of geologists still seem to think that the fossils in general agree with the standard order, we must remember how many sharp-eyed observers said the same thing for decades about Werner's scheme. The taint of heredity will always come out sooner or later; and both of these schemes exhibit very strongly the

[9] "Illustrations of Universal Progress," p. 343.

family history of the whole tribe of Cosmogonies, for *the facts refuse to certify that they are of sound mind.*

IV

It was William Smith (1769-1839), an ignorant English land surveyor, who first conceived the idea of fixing the relative ages of strata by their fossils.[10] Just how far he carried this idea, it seems difficult to determine exactly. Lyell[11] says nothing along this line about him, save that he followed the leading divisions of the Secondary strata as outlined by Werner, though, he claims, "independently" of the latter. Whewell[12] remarks rather pityingly on his having had "no literary cultivation" in his youth, but says nothing about the degree in which he is responsible for the modern scheme of life-succession of which many modern geologists have made him the "father." Geikie and Zittel are much more explicit. The former[13] says that "he had reached early in life the conclusions on which his fame rests, and he never advanced beyond them." "His plain, solid, matter-of-fact intellect never branched into theory or speculation, but occupied itself wholly in the observation of facts." Zittel[14] says pretty much the same thing, remarking that "Smith confined himself to the empirical investigation of his country, and was never

[10] A French writer, Abbé Giraud-Soulavie (1752-1813), seems to have preceded Smith with this idea; but his writings were not regarded by others, and seem to have had no influence on the subsequent history of the development of the science.

[11] "Principles," 8th ed., p. 50.

[12] "History of the Inductive Sciences," Vol. 2, p. 521.

[13] "Founders of Geology," pp. 237, 238.

[14] "History," p. 112.

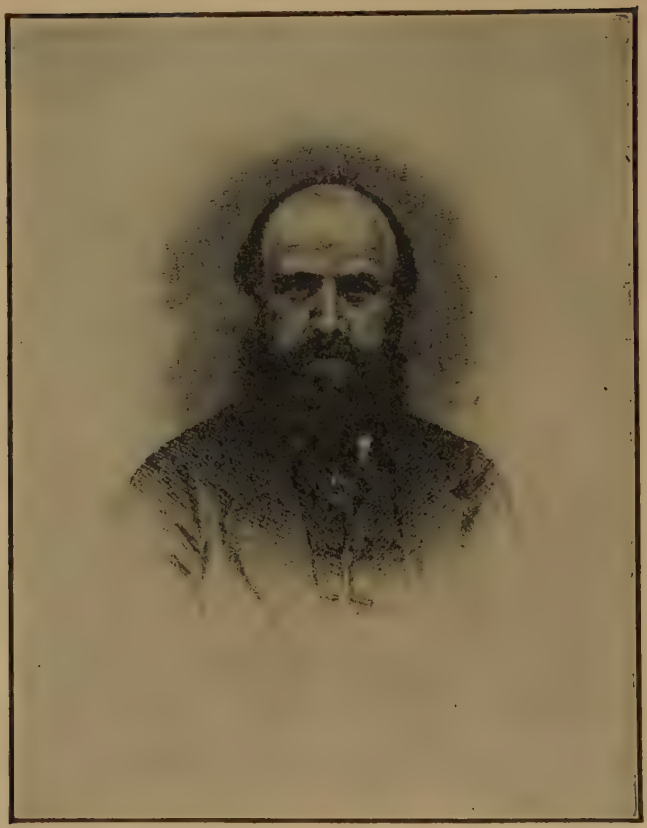

FIG. 11. William Smith (1769-1839), often called "Strata" Smith, also the father of English geology.

tempted into general speculations about the history of the formation of the earth''—words which to my mind are the very highest praise, for they seem to indicate that he was only in a very limited way responsible for the unscientific and illogical scheme of a

"phylogenic series" or complete "life-history of the earth," which now passes as the science of geology.

The following may be taken as a fair statement of what he actually accomplished and taught:

> "After his long period of field observations, William Smith came to the conclusion that one and the same succession of strata stretched through England from the south coast to the east, and that each individual horizon could be recognized by its particular fossils, that certain forms reappear in the same beds in the different localities, and that each fossil species belongs to a definite horizon of rock."[15]

But even granting the perfect accuracy of this generalization of Smith's for the rocks which he examined, I fail to see how it is any better than Werner's scheme, which Zittel characterizes as "weak" and premature, and of which Whewell[16] says that "he promulgated, as respecting the world, a scheme collected from a province, and even too hastily gathered from that narrow field."

Quoting again from Zittel's criticism of Werner's work,[17] we must admit that Smith's observations also were "limited to a small district," and "his chronological scheme of formations was founded upon the mode of occurrence of the rocks [fossils] within these narrow confines."[18] There is, as we have shown, a monstrous jump from this to the conclusion that even these particular fossils must always occur in this particular relative order over the whole earth. How

[15] Ibid.

[16] Page 521.

[17] "History of Geology," p. 59.

[18] It should be noted that all these rocks in England thus examined by Smith make up only a small fraction of the total geological series — largely what we now call the Jurassic and Cretaceous rocks.

can anyone deny that if we had a complete collection of *all* the fossils laid down during the last thousand years — when all admit that the so-called "phylogenic series" is complete — *particular fossils would, in many cases, be found to occur only in particular rocks,*[19] and often be associated with only certain kinds of minerals, such as clay, limestone, or sand, and we could still arrange them in this same artificial order from the lowest to the highest forms of life, while we might even find "small districts" where the "mode of occurrence of the rocks within these narrow confines" would happen to have all the appearance of showing a true "phylogenic" or taxonomic order? At any rate, every one knows that when we find, let us say, one plant belonging to the Heath family, we are very likely to find a dozen or two dozen species of this same family in the immediate vicinity; and the same is true of thousands of other groups. All of which only means that even in our modern world, groups of related species are often segregated together, and occur in particular localities only; while the same or similarly associated groups of species may recur here and there in localities widely separated from one another. These things ought to be sufficient to show us the weakness of this subjective method of study, and the purely hypothetical and artificial value of the fossils in determining the real age of a rock deposit; because *the geological classifications really represent taxonomic values; they are*

[19] "The plants and animals of different geological periods do not differ more from one another than those in opposite climates, or even distant localities, at present."—"Manual of Geology," Phillips, p. 628, 1855.

merely a card catalogue of the buried floras and faunas of the ancient world. The "phylogenic series" is nothing more than an old-time taxonomic series, and there is absolutely nothing at all to prove that it represents succession in time.

V

The name of Baron Cuvier (1769-1832) is the next that we have to consider. An examination of part of his teaching will come naturally a little later, when we consider "extinct species." That part of his work which related to the doctrine of catastrophism is somewhat aside from the subject of our study; while with regard to his influence on the succession-of-life idea *per se* there is not very much that need be said. Yet Cuvier is the real founder of modern cosmological geology, and thus in a certain sense the father of organic evolution.

But if the absence of the architectonic mania for building a cosmogony will serve to remove in a great measure any suspicions with regard to William Smith's results, we can not say the same for those of Cuvier. In his scheme, the hereditary cosmological taint, which is such an invariable characteristic of the family, is very strong, though disguised and almost transfigured by learning and genius. Doubtless these latter qualities have secured for the theory its phenomenal length of life; though, of course, we know that nothing born of this whole brood of subjective speculations can ever secure a permanent home in the kingdom of science.

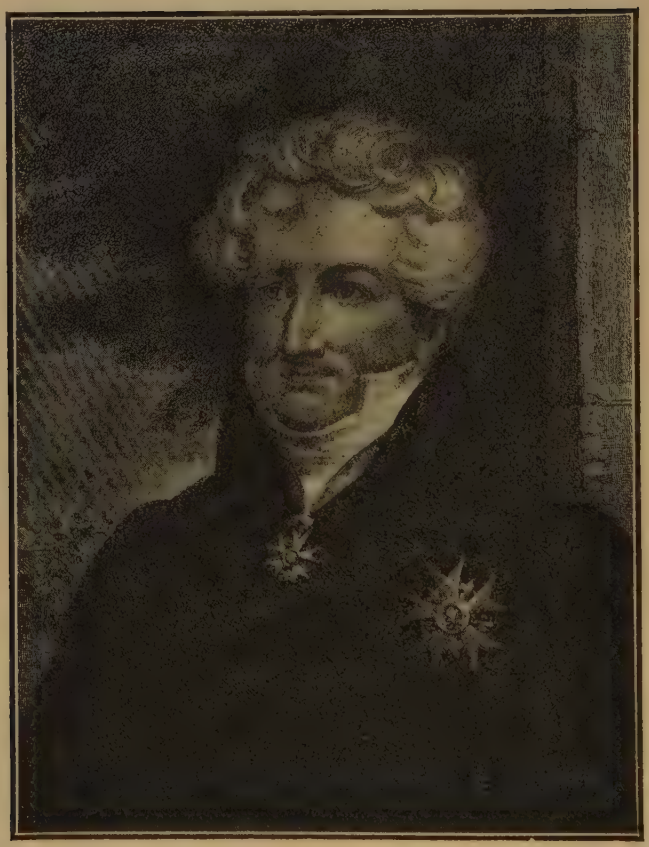

FIG. 12. Georges Cuvier (1769-1832), founder of the old doctrine of "catastrophism," which was rather a doctrine of creation on the installment plan.

"How glorious," wrote this otherwise truly great man, in his famous "Preliminary Discourse," "it would be if we could arrange the organized products of the universe in their chronological order, as we

can already [Werner's onion-coats] do with the more important mineral substances!"

His work (with that of his colaborer Brongniart) on the fossils of the Paris basin was probably accurate and logical enough for that limited locality. Only when he quietly assumed, as Werner had done, that the rocks must always occur in this particular order all over the world, or as Whewell expresses it, "promulgated as respecting the world, a scheme collected from a province, and [perhaps] even too hastily gathered from that narrow field"— only, I say, when this monstrous assumption was incorporated into his scheme, and he began to call into being his "glorious" vision of organic creation on the installment plan, as Werner had done with the minerals, did his great and valuable work for science become tainted with the deadly cosmological virus, dooming it to death sooner or later. Sherlock Holmes might attempt to diagnose a disease by a mere glance at his patient's boots; but even this gave him more pertinent data and

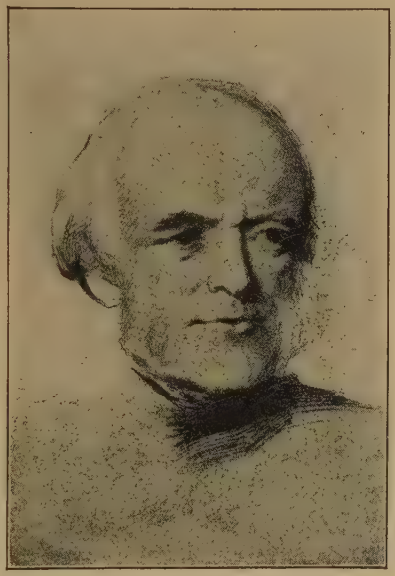

Fig. 13. Sir Charles Lyell (1797-1875).

was a more logical proceeding than the facts and methods of Cuvier supplied for constructing a scheme of organic creation.

VI

Sir Charles Lyell was not only the great apostle of uniformitarianism; he was also the chief one who developed and perfected the plan of classifying the rocks according to their fossil contents. He took up the ideas of Smith and Cuvier, and made them popular among other geologists, building also on the results of the field work of Murchison and Sedgwick in England, and of others in the State of New York and elsewhere. James D. Dana "was the first to classify and teach the facts of geology from a purely historical point of view."[20]

VII

It will not be necessary to give further details of the manner in which the modern "phylogenic series" was gradually pieced together from the scattered fragments here and there all over the globe. Yet we should note here that the whole chain of life was practically complete before any serious attempt was made to study the rocks on the top of the ground, and to find out how this marvelous record of the past *joined on to the modern period.* Thus the true scientific method was completely reversed, the most important of all — that is, the rocks containing human remains and other *living* species — being left over till the last, with the result that we have for over half

[20] "Geological Biology," H. S. Williams, pp. 24, 25.

a century been laboring under a "glacial nightmare," and these deposits on the top of the ground "still remain in many respects the despair of geology."[21]

In the meantime, many attempts had been made to teach a theory of descent or evolution. Erasmus Darwin, the grandfather of Charles Darwin, published a book in 1796 advocating this idea; while Lamarck in 1809, and others soon after, tried to embellish this and make it plausible with all the scientific knowledge then obtainable. Lamarck's theory was based on spontaneous generation, and on the alleged power to transmit to posterity the characters acquired during the lifetime of the parent, particularly the characters acquired as the effects of use and disuse.

To all these evolutionary theories, the commanding genius and scientific renown of Cuvier were in direct opposition. By the year 1830, the conflict had become acute; and by Cuvier's victory that year over Geoffroy Saint-Hilaire, the theory of successive distinct creations remained the only thing recognized as science. Indeed, from this date onward for several decades, the theory of evolution "sank into oblivion," to use the words of August Weismann, "and was expunged from the pages of science so completely that it seemed as if it were forever buried beyond hope of resurrection."[22]

In further description of the evolutionary theories as then presented, we have the following:

"All sorts of vague speculations were indulged in; and these contributed less and less to the support of the theory

[21] Howorth.
[22] Smithsonian Report, 1909, p. 433.

the more far-reaching they became. Many champions of the 'Naturphilosophie' of the time, especially Oken and Schelling, promulgated mere hypotheses as truths; forsaking the realm of fact almost entirely, they attempted to construct the whole world with a free hand, so to speak, and lost themselves more and more in worthless phantasy. This naturally brought the theory of evolution, and with it 'Naturphilosophie,' into disrepute, especially with the true naturalists, those who patiently observe and collect new facts. The theory lost all credence, and sank so low in the general estimation that it came to be regarded as hardly fitting for a naturalist to occupy himself with philosophical conceptions."[23]

But in the meantime, a more detailed knowledge of rocks, plants, and animals was gathered; and with the doctrine of creation represented only in burlesque by the successive ages of Cuvier, it was inevitable that the seeming victory of the latter could be only short-lived, so that the following years were marked by the rise of the modern view of geology and biological evolution, under Lyell (1797-1875), Agassiz, and Darwin, a feature of the history that is too familiar to need repetition here. But it must be noted in passing, that, as the results of the keen discussions regarding the transmission of acquired characters, which were started by Weismann in the later eighties of the last century, the modern world has about settled two of the chief points involved, namely:

1. That so far from natural selection's being able to originate a new species, it can not really originate anything at all, or, in the words quoted with approval by Hugo de Vries, "it may explain the survival of the

[23] Id., p. 432.

fittest, but it can not explain the arrival of the fittest;''[24] and—

2. That changes in the individual induced by environment or by use and disuse of organs are not transmitted to offspring, as has been abundantly shown by Weismann, Wallace, Lankester, and others.

Hence it is hard to see what there is left of what is generally known as Darwinism.

The present position of the theory of organic evolution can not be better stated than in the words of D. H. Scott, President of the Section on Botany, at the meeting of the British Association for the Advancement of Science, at Edinburgh, September 9, 1921:

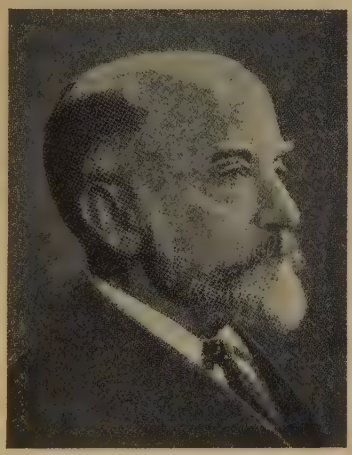

Fig. 14. Dr. D. H. Scott 1854-

''It has long been evident that all those ideas of evolution in which the older generation of naturalists grew up have been disturbed, or, indeed, transformed, since the re-discovery of Mendel's work and the consequent development of the new science of genetics. Not only is the 'omnipotence of natural selection' gravely impugned; but also variation itself, the foundation on which the Darwinian theory seemed to rest so securely, is now in question.

''The small variations, on which the natural selectionist relied so much, have proved, for the most part, to be merely

[24] ''Species and Varieties,'' pp. 825, 826.

fluctuations, oscillating about a mean, and therefore incapable of giving rise to permanent new types. . . .

"At present all speculation on the nature of past changes is in the air, for variation itself is only an hypothesis, and we have to decide, quite arbitrarily, what kind of variations we think may probably have occurred in the course of descent. . . .

"For the moment, at all events, the Darwinian period is past; we can no longer enjoy the comfortable assurance, which once satisfied so many of us, that the main problem had been solved — all is again in the melting pot. By now, in fact, a new generation has grown up that knows not Darwin.

"Yet evolution remains — we can not get away from it, even if we hold it only as an act of faith, for there is no alternative, and, after all, the evidence of paleontology is unshaken."[25]

The address of Dr. William Bateson before the American Association, at Toronto, December 28, 1921, expressed very similar sentiments. This address, which was entitled "Evolutionary Faith and Modern Doubts," was essentially a declaration of complete agnosticism regarding all the theories hitherto proposed for the origin of species. Among many similar expressions, the following may be regarded as representative:

"We can not see how the differentiation into species came about. Variation of many kinds, often considerable, we daily witness, but no origin of species."[26]

Bateson dwelt at some length on the fact that, with the biological clues all failing them, scientists can now rely only on the outline of successive forms of life as furnished by geology; though he did not seem to have any suspicion that the geological evi-

[25] *Nature*, Sept. 29, 1921.
[26] *Science*, Jan. 20, 1922.

dence would ever be invalidated. On this point he spoke as follows:

"Where is the difficulty? If the angiosperms came from the Carboniferous flora, why may we not believe the old comfortable theory in the old way? Well, so we may, if by belief we mean faith, the substance, the foundation of things hoped for, the evidence of things not seen. In dim outline, evolution is evident enough. From the facts [of geology] it is a conclusion which inevitably follows. But that particular and essential bit of the theory of evolution which is concerned with the origin and nature of *species* remains utterly mysterious. We no longer feel, as we used to do, that the process of variation, now contemporaneously occurring, is the beginning of a work which needs merely the element of time for its completion; for even time can not complete that which has not yet begun."[27]

Thus we see the leading biologists of the world freely confessing that the whole supposed biological foundation of the evolution doctrine is already gone, and that only the geological outline, or that supposed to be furnished by paleontology, now remains. How much of this geological foundation really remains, however, the reader may judge after he has read the remainder of this present volume.

Of course, it has long been evident to most careful thinkers that our scientific demarcation of species has been made on altogether too narrow lines. They are not all species which are called species and which have their names in the systematic lists. The "splitters" have long had things pretty much their own way, with the result that we now have on our hands multiplied thousands of names of "species" of plants and ani-

[27] Idem.

mals that could never stand the test of breeding, and still other multitudes that do not seem to be more distinct from one another than plenty of Mendelian segregates, though for some reason they seem to be either cross-sterile with other related forms, or at least they maintain their identity in nature in some way not clearly understood.

On the one hand, it seems eminently reasonable that such well-established species as the yak and zebu of India, the bison of America, the aurochs of Europe, and our common domestic cattle have all sprung from some common stock. The same may be said of the twenty-odd species of wild pigs scattered over the globe, all of which, as Flower and Lydekker tell us, would probably breed freely together.[28] I consider it highly probable that all the members of the cat family (*Felidæ*) have had a common origin; that all the *Canidæ* are of a common descent; and so on all through the plant and animal kingdoms. As I have pointed out elsewhere,[29] it is evidently *the family that we must look upon as the primary organic unit,* the genera and species and varieties having originated from some common original by something like Mendelian segregation, though most of this differentiation was evidently accomplished away back very early in the history of the world. In the light of these facts, the long discussions which we have had regarding the origin of species have resulted in an enlargement of our permanent stock of knowledge regarding living forms.

[28] "Mammals Living and Extinct," pp. 284, 285.
[29] "The Phantom of Organic Evolution," pp. 97, 98.

On the other hand, it seems practically certain that neither natural selection nor the inheritance of acquired characters has largely or perhaps at all been concerned in bringing about the present diversity among plants and animals, even such diversity as can reasonably be supposed to have come about since an original creation of the great family types.

In short, the whole biological field seems about worked out all around, so far as this problem is concerned; and the net results appear to be that, while there has been variation in plenty among the plants and animals about us, far more and greater variation than was formerly supposed, yet life seems to be walled in by certain impassable limits beyond which it has never yet been found possible to carry the results of any artificial or natural change; while the theory of spontaneous generation, an indispensable part of any scheme of organic evolution, is dead for all coming time.

We have not the space to show in detail how Agassiz (1807-1873) further complicated the problem immensely by an absurdly illogical use of his three "laws" of comparison between the embryonic development of the modern individual and the phylogenic series manufactured to fit it, when the prime fact of there ever having been a succession of life on the globe in any order whatever had never been proved objectively; but I am free to say that if Cuvier's system of creation on the installment plan had been fact instead of fancy, some method of evolution would undoubtedly be implied in this general fact. It is this

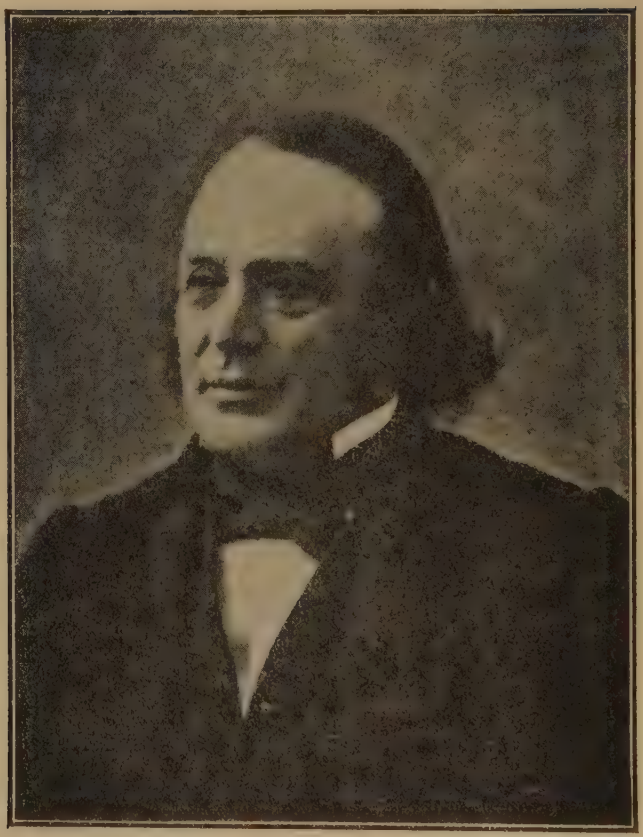

FIG. 15. Louis Agassiz (1807-1873). He might well be called the father of natural science in America.

instinctive feeling on the part of modern scientists which makes them to-day, while confessing the failure of Darwinism, still cling to the general idea of evolution somehow. Hence it seems quite evident that, having deviated from strict inductive methods by

pursuing this *ignis fatuus* of a cosmological history of creation, it was essential in the interests of true science to go the whole journey, even though it was leading up a blind alley, and make a complete investigation of both the biological and the geological side of the question, in order to complete the demonstration that science was on a wrong track entirely, and that creation was not brought about in any such way. Darwin and Weismann and Mendel were inevitable in view of the wholly unscientific course on which biology entered under the guidance of Buffon and Cuvier; and Howorth and Suess were as inevitable in demonstrating the folly of trying to explain the past geological changes by the uniformitarianism of Hutton and Lyell. Uniformity and evolution have had a fair chance, an open field, and have done their best. But they have failed, miserably failed.

VIII

What, then, can we take as the general lesson to be learned from the stubborn way in which, for more than a hundred years, the world has followed this hypnotic suggestion of folly that we might explain the origin of our world from the scientific standpoint as only just like things that are now going on? — One of the lessons — there may be others — is that science knows nothing about the details or order of creation, for these are wholly beyond its sphere; and that, in our speculating along these lines, the cosmological taint will always vitiate the accuracy of our conclusions and debauch the true spirit of induction. A

hundred years ago, some leaders of natural science thought they knew all about how the world was made. Wholly immune from doubt, they thought they had discovered what they had only invented — a mere empty shadow of their minds' own throwing. The keen investigations inspired by Darwinism, Lyellism, and Mendelism were necessary to convince us that in a scientific way we know nothing at all about it. Modern science has simply developed a gigantic negative demonstration that the making of the world did *not* occur by a gradual and long-drawn-out progression from the low to the high, and by processes similar to what is now going on; and the evolution doctrine has been only a by-product in this demonstration. A hundred years — nay, fifty years — ago this assumption did not appear so unscientific, for we did not then have the biological and the geological evidence to refute such an idea. Now, however, in the light of the modern progress of science, this awful mystery of our existence, of our creation and destiny, is borne in upon us from every dividing cell, from every sprouting seed, from countless millions of the eloquent voices of nature, which our forefathers were too blind to see, too deaf to understand; and with weary, reluctant sadness does human science confess that about the origin of all these things she knows absolutely nothing.

It is important to make this point clear; for it is the very quintessence of modern science, the net result of all our investigations. What we have observed, what we know, is science (Latin, *scio*, I

know). But when all our investigations only impress us the more deeply with the conviction that we do not know anything and can never hope to know anything in a scientific way of *how* the world was made, or how life or the species of animals and plants came into existence, the conclusion is inevitable that *creation was something different, essentially and radically different, from what is now going on.* The central idea of the evolution doctrine is *uniformity,*—that is, that what is now going on is identical with or similar to what has always been going on; that the present operations of nature are as much a part of creation as anything that ever took place in the past. But the net results of modern science are against all this. In other words, they teach creation, not evolution. They assure us, with words that are all the more convincing because they have been forced from unwilling lips, that there must have been a real, immediate creation at the beginning, essentially different from anything now taking place. The opening words of the Christian's Bible are at last being vindicated by modern science: "In the beginning God created the heaven and the earth."

CHAPTER III

Finding Bottom: Fact Number One

I

We must now change our method of investigation from the deductive to the inductive form.

Hitherto we have been dealing with only the *a priori* aspects of the succession-of-life idea. We have seen that it is a complex idea, and really involves two primary assumptions, namely:

1. That in the long ago there were no zoölogical provinces and districts, and totally different types could not have been living contemporaneously in widely separated localities,—which is only the modern form of the onion-coat theory stated negatively; and also—

2. That over all the earth, the fossils must always be found occurring in the particular order in which they were first found in a few corners of western Europe.

We have dealt with only the *first* of these assumptions in the first chapter of this book. The whole idea is confessedly intricate, and very few even among geologists have done enough persistent, calm thinking on the subject to get any clear ideas regarding it. Most of them profess to discard the old onion-coat theory, and claim to believe in zoölogical provinces and districts in the olden time. But it is obvious

that if the latter notion is honestly and persistently adopted, we must not dogmatically put any limits to the diversity of plants and animals that may have coexisted in widely separated localities in the long ago. That is, mammals may have been living on the land while trilobites were living in the sea; or the nummulites may have been contemporary with the graptolites; or oaks, elms, and beeches, contemporary with the lepidodendrons and the sigillaria. But since the current theories indignantly deny these latter possibilities, it is only in effect to deny the existence, in the ancient time, of zoölogical provinces and districts, and to adopt the biological form of the onion-coat theory. These are the two horns of the dilemma. There is no third choice.

But it is self-evident that the *second* of the above-mentioned assumptions must *also* be involved in the geological succession of life; that is, the fossils must invariably be found occurring all over the globe in the very same order of sequence as in the "standard" order found in Europe and New York State. It is on the blending of these two assumptions: *first,* the denial of zoölogical districts and zones in the world in which the fossils lived; and *second,* the invariable relative order of the fossils,— the first essentially absurd, and the second long ago disproved by a multitude of discoveries,— it is on the blending of these two preposterous assumptions that the complete geological series from the Cambrian to the Pleistocene has been built up. For it is obvious that not merely one, but *both* of these assumptions must be true in

order to establish the geological life-succession. But since, as we shall presently see, the second is as false as the first is arbitrary and absurd, the whole theory of the successive ages is left without any defense in logical or scientific reasoning and without support in concrete objective fact.

The curious way in which, as we have seen, Spencer, Huxley, and others have treated this fundamental point, reminds us of the old advice, "When you meet with an insuperable logical difficulty, look it steadfastly in the face,—and pass on." For neither they nor any of their thousands of followers have ever, so far as I know, pointed out the grotesque logic in taking this immense complex of guesses and assumptions as the starting point for new departures, the solid foundation for detailed "investigations" as to *just how* this wonderful phenomenon of development has occurred. For after Agassiz and his contemporaries had built on these large assumptions of Cuvier, and had arranged the details and the exact order of these successive forms by comparison with the embryonic life of the modern individual, the evolutionists of our time, led by such men as Spencer and Haeckel, with their "biogenetic principle," *prove*(?) their theory of evolution by the assertion that the embryonic life of the individual is only "a brief recapitulation, as it were from memory," of this (artificial) geological succession. There would really seem to be little hope of reaching with any arguments a generation of scientists who can elaborate genealogical trees of descent for the different families and genera of the

animal kingdom, based wholly on such a series of assumptions and blind guesses, and then palm off their work on a credulous world as the proved results of *inductive* science.

Yet I am tempted to make some effort in this direction. I do not wish to attach any blame to the founders of the science; but it surely is permissible to point out where they may have made mistakes. Fifty years ago — nay, twenty-five years ago — we did not have the facts which are now at hand. But since we have quite fully examined the various aspects of the *a priori* argument under the head of the onion-coat theory, there now remains the work of testing the *second* of the assumptions mentioned above, by the facts of the rocks. This work of seeing whether or not the order of the fossils always agrees with the order first established in western Europe and New York State, will be the subject of this and the two following chapters.

It is not possible to examine further the *first* of these assumptions; that is, the implicit denial of biological realms, districts, and zones in the long ago. Nor is there any need of doing so; because this or any other phase of the onion-coat theory is quite evidently beyond the pale of sober scientific discussion. For if any one has so far forsaken the paths of inductive science as to dogmatize about a time in the past when there were no zoölogical provinces and districts, but only one and the same assemblage of life-forms everywhere on earth, there is no use attempting to reason with him until he gets back on solid ground once

more. Hence it remains now simply to test by the facts of the rocks *the second assumption; namely, that all over the earth, the fossils invariably occur in the particular order in which they were first found in a few corners of western Europe* by the founders of the science. Have we already a sufficiently broad knowledge of the rocks of the world to decide such a question?—I think we have.

II

To begin, then, at the beginning, let us try to find out how we can fix on the rocks that are undeniably the *oldest* on the globe. We should expect to find a good many patches of them here and there; but there must be some common characteristic by which they may be distinguished wherever found, and some way by which we may be sure they are the oldest. Of course, when I say "rocks" here, I mean fossils; for as has long been agreed by geologists, mineral and mechanical characters are of practically no use in determining the age of deposits, and we are here dealing only with life and the order in which it has occurred on the globe. Accordingly, our problem is really to find that typical group of fossils which is essentially older than all dissimilar groups of fossils.

In most localities, we do not have to go very far down[1] into the earth to find granite or other so-called

[1] When the textbooks speak of thirty miles' thickness of the fossiliferous rocks, the reader should remember how the rocks have to be patched up together from here and there to make this incredible thickness, as only a small fraction of such a thickness exists in any one place. Two or two and a half miles of stratified rocks is the maximum that we actually find in any given locality, aside from theoretical considerations. In most places it is one mile or less.

igneous rocks, which not only do not contain any traces of fossils, but which we have no proper reason for supposing ever contained any. These Azoic or Primitive rocks constitute practically all the earth's crust, there being only a thin skin of fossiliferous strata on the outside, like the skin of an apple. Now it would be natural enough to suppose that those fossils which occur at the bottom, or *next to the Primitive, or Archæan,* are the oldest. This is doubtless what the earlier geologists had in mind, or at least ought to have had in mind, though it is not quite certain that they had any clear thoughts on the matter whatever. They did not really begin at the bottom, but halfway up, so to speak, at the Mesozoic and Tertiary rocks; and Sedgwick and Murchison, who undertook to find bottom, became too excited over their Cambro-Silurian controversy to attend to so insignificant a detail as the logical proof that any type of fossil was really older than all others. Had they stopped to consider that some type of fossil might occur next to the Archæan in Wales, and another type occur thus in Scotland, while still another type altogether might be found in this position in some other locality, and so on over the world, leading us to the very natural conclusion that in the olden times, as now, *there were zoölogical provinces and districts,* in other words, that very different types coexisted in separate localities, the history of science during the nineteenth century might have been very different, and this chapter might never have been written. But this commonplace of modern geology, that any type

of fossil whatever, even the very "youngest," may occur next to the Primitive, or Archæan, was not then considered or understood; and when, about 1830, it came to be recognized, other things were allowed to obscure its significance, and the habit of arranging the rocks in chronological order according to their fossils was too firmly established to be disturbed by such an idea.

It was long thought that the "Olenellus" beds were the oldest fossiliferous deposits. They were first described from Scandinavia, but have since been found in Newfoundland, the Rocky Mountains, and elsewhere. Of late years, however, other rocks have been distinguished in these same regions as still older, and have been called Pre-Cambrian, Algonkian, and by various other names that refer to the same deposits. They consist of conglomerates, sandstones, graywackes, quartzites, slates, and limestones, and contain traces of protozoans, cœlenterates, echinoderms, brachiopods, mollusks, worms, and arthropods, though these fossils are extremely scarce and not very well preserved. The reasons for calling these rocks older than any Cambrian beds are too technical to be given here in detail; but the argument consists essentially of two points: (1) They are sometimes found stratigraphically below beds classed as Lower Cambrian, and (2) they contain, in the aggregate, fossils of more "generalized" structure than those of the Cambrian. Accordingly, these Algonkian, or Pre-Cambrian, beds are regarded as the oldest fossiliferous deposits on the globe.

III

Now, granting these two facts as stated, where are we in point of strict logic and demonstrable science? —Quite obviously we are just where we started in the first chapter of this book. For shall we say (1) that when these Pre-Cambrian forms were living in these localities, there could have been no other distinctly different forms of life living elsewhere? or shall we boldly and baldly assume (2) that at one time these beds were actually universal around the globe, like Werner's onion-coats? There is no third choice. It must be either the one or the other. But to hold openly to either of these alternatives, is surely not a very comfortable position for any one to be placed in who wishes to pass as a scientist. In no other department of modern thought could such postulates be seriously considered for a minute, and the time must soon come when they will be regarded as anachronisms even in geology.

On the other hand, on what scientific grounds do we actually know that the smallest and lowest (structurally) or more "generalized" types must have actually lived many thousands or millions of years *before* other types which we regard as "higher" or more "specialized"? Is this idea capable of defense as a scientific axiom? And is it sufficiently axiomatic and self-evident to serve as a secure basis of not only geology but of all biological science? Surely there is no need of pointing out that in strict logic *this assumption begs the whole question of organic evolution.* What is the use of any further investigation or

discussion if we already know that the lowest or more generalized types of life came into existence first, and the higher and more specialized only long ages afterwards? Or how can we be sure beforehand that this is what the rocky record is going to reveal to us? To resume an illustration used on a previous page, how is our amateur librarian to be sure of the fact that all the A's and B's in his newly discovered library were all printed first, and long before the X's and Y's and Z's? Evidently it will not do to assume the very thing we are trying to prove if we are to call our study a scientific investigation.

Thus we are restricted to the one sensible and really scientific fact regarding these beds; namely, their stratigraphical position. For any given limited locality, where stratigraphy can be followed out, the lowest beds are certainly the oldest. But we can make no progress by such a method when we come to deal with the world at large, for actual stratigraphical relationships can be proved over only very limited areas. These beds may be the lowest in this locality, may rest on the granite or crystalline schists, and have every appearance of antiquity. But other beds, containing very different fossils, are in precisely this position elsewhere, and where stratigraphical order can no more prove the relative age of their fossils than the overlap of scales on a fish proves those at the tail to be older than those at the head.

For the Fact Number One, which I have chosen as the subject of this chapter, is the now well-established principle that *any kind of fossiliferous*

rock whatever, even "young" Tertiary rocks, may rest upon the Archæan or Azoic series, or may themselves be almost wholly metamorphosed or crystalline, thus resembling in position and outward appearance the so-called "oldest" rocks.

The first part of this proposition, about any rocks occurring next to the Archæan, is covered by the following quotation from Dana:

"A stratum of one era may rest upon any stratum in the whole of the series below it,—the Coal Measures on either the Archæan, Silurian, or Devonian strata; and the Jurassic, Cretaceous, or Tertiary on any one of the earlier rocks, the intermediate being wanting. The Quaternary in America in

FIG. 16. Contorted beds of Potomac (L. Cretaceous or Comanchean of the Atlantic) formation, resting on crystalline schists (Archæan), Belt Line R. R., Baltimore, Maryland. (Darton, U. S. G. S.)

FIG. 17. Heidelberg Castle, Germany. In the moat of this castle may be seen Mesozoic strata resting upon Archæan rocks.

some cases rests on Archæan rocks, in others on Silurian or Devonian; in others on Cretaceous or Tertiary.''[2]

Nearly everywhere throughout Tennessee, eastern Mississippi, and into Alabama, the Cretaceous strata "overlap Paleozoic strata, and in Georgia they rest on the more ancient crystallines.''[3] Throughout much of the Rocky Mountain region, the Triassic beds rest directly upon the Primary or Pre-Cambrian (of course, unconformably); and the same condition runs down over the greater part of Mexico and Central America. In Cuba and Jamaica the Cretaceous rest

[2] ''Manual,'' 4th ed., p. 399.
[3] ''Textbook of Geology,'' Schuchert, ed. 1915, p. 899.

directly upon old crystallines.[4] The Mesozoic strata usually occur in this position through Saxony and Bohemia; and it was on this account that they were formerly called "Secondary." In California, the Tejon (Eocene) rocks rest often upon the old granites and gneisses.

It would be tedious to multiply testimony on a point so universally understood and acknowledged.

As for the other half of this Fact Number One, that even the so-called "youngest" rocks may be metamorphic and crystalline, just as well as the "oldest," it also is now a commonplace of geological science. Dana says that as early as 1833, Lyell taught this as a general truth, applicable to "all formations, from the earliest to the latest."[5]

But the full converse of this Fact Number One is equally true. The very oldest fossiliferous rocks may not only be at the surface, as might be expected in many instances; but some of them still remain just as soft and unconsolidated as any of the Tertiaries or the Pleistocene. That is, in all their physical characters they look as young as any of the strata of the entire geological series. "In the Baltic province and in parts of the United States, the rocks still retain their original horizontality of deposition, the muds are scarcely indurated and the sands are still incoherent."[6]

The areas in the United States to which reference seems to be made in this quotation, occur in the Lake

[4] "Textbook," Grabau, Vol. 2, p. 696.
[5] "Manual," p. 408.
[6] John Allen Howe, in Encyclopedia Britannica, 11th ed., Vol. 5, p. 86.

Superior region; but it seems that even the Penokee series of this region, regarded as a subdivision of the Algonkian or Pre-Cambrian, is also in the same unaltered and unconsolidated condition.[7]

The same condition prevails with reference to the Ordovician, which is the system rated as next in age to the Cambrian. "Across northern Russia Ordovician rocks cover a great area; they consist of clays, bituminous and calcareous shales, sands, and marls." "They lie flat and undisturbed, . . . the sands and clays are as soft and incoherent as the similar rocks of Tertiary age in the south of England."[8]

The Cretaceous beds of Tennessee, Mississippi, and Alabama are of the same character. They consist of unconsolidated gravels, sands, and clays, and look as young as any "late" Tertiary or Pleistocene beds. And while the Cretaceous rocks are not regarded as "old" geologically, they are sufficiently ancient, according to the current theory, to make it utterly incredible that they could be still in this soft, unconsolidated condition. Their every appearance is certainly against the theory of their being millions of years old; while the examples which I have quoted above of Cambrian and Ordovician rocks also in the same condition, is one of the standing wonders of geological science,— that is, in the minds of those who believe the current theories. There is nothing wonderful about any of these examples if we discard the theory of their being really older than other rocks

[7] "Age of the Earth," W. J. Sollas, pp. 29, 30.
[8] Encyclopedia Britannica, Vol. 20, pp. 237, 236.

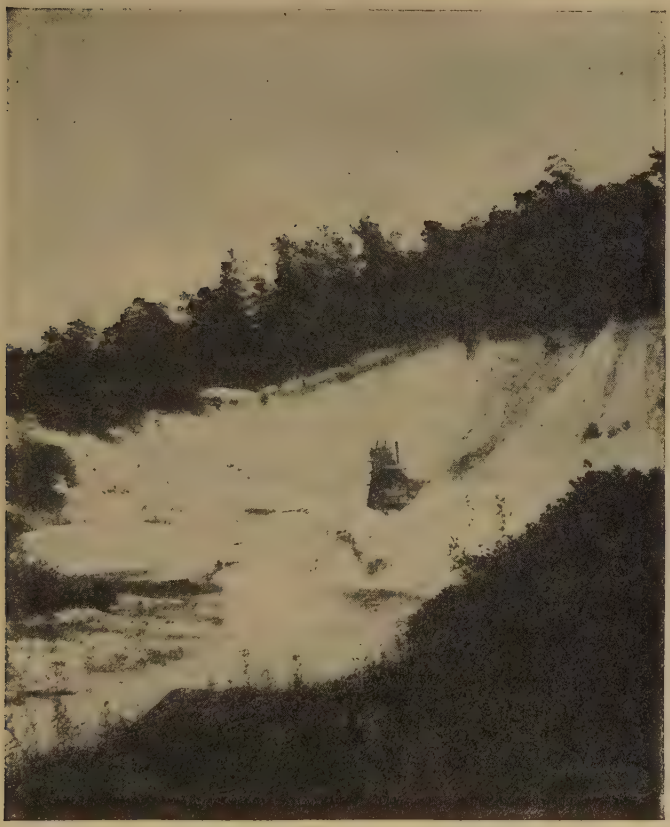

FIG. 18. Soft Cretaceous clays and sands, near Sea Cliff, Long Island, New York. Worked for the sand. (Fuller, U. S. G. S.)

elsewhere which may be classed as Tertiary or Pleistocene.

The first reference I can find to any disproof of this old fable of Werner's, that only certain kinds of rocks are to be found next to the Primitive, or

FIG. 19. Potomac (L. Cretaceous or Comanchean) gravel and arkose, at Richmond, Virginia. This material is sufficiently soft and unconsolidated to be worked with pick and shovel. It certainly does not look to be ten or twenty million years old. (Darton, U. S. G. S.).

Archæan, is in the observations of Studer and Beaumont in the Alps (1826-1828), who found "relatively young" fossils in crystalline schists, which, as Zittel says, "was a very great blow to the geologists who upheld the hypothesis of the Archæan or Pre-Cambrian age of all gneisses and schists."

James Geikie, doubtless referring to the same series of rocks, tells us that "in the Central Alps of Switzerland, some of the Eocene strata are so highly metamorphosed that they closely resemble some of the most ancient deposits of the globe, consisting, as

they do, of crystalline rocks, marble, quartz rock, mica schist, and gneiss."[9]

The "young" Tertiary beds of the Coast Range and of various other parts of California "are folded or otherwise altered so that they are as much consolidated as are the formations of the Paleozoic."[10] The same is true of the gold-bearing Jurassic slates of the Sierra Nevada range. Eocene marbles of the Himalayas are also highly crystalline. Even the Pleistocene Nagelfluh of Salzburg, Austria, is a noted example of highly consolidated "young" beds; for catacombs and chapels were carved out of it in the third century, and these rooms are practically as good as ever. A similar example of consolidated Pleistocene rock requiring a hammer to break it, is found near the railway station at Lewiston, on the Niagara River.

Hence we need not be surprised at the following statement of the situation by Zittel:

"The last fifteen years of the nineteenth century witnessed very great advances in our knowledge of rock deformation and metamorphism. *It has been found that there is no geological epoch whose sedimentary deposits have been wholly safeguarded from metamorphic changes;* and as this broad fact has come to be realized, it has proved most unsettling, and has necessitated a revision of the stratigraphy of many districts in the light of the new possibilities. The newer researches scarcely recognize any theory; they are directed rather to the empirical method of obtaining all possible information regarding microscopic and field evidences of the passage from metamorphic to igneous rocks, and from metamorphic to sedimentary rocks."[11]

[9] "Manual of Historical Geology," p. 74.
[10] "Textbook," Schuchert, p. 911.
[11] "History," p. 360.

But in addition to what Zittel means by recognizing "no theory" as to the origin of the various sorts of igneous rocks, it seems to me that this "broad fact" ought surely to prove "most unsettling" to the traditional theories about certain fossils' being intrinsically older than others. With our minds divested of all prejudice, and this "broad" Fact Num-

FIG. 20. Maximus Chapel, in the catacombs of Salzburg, Austria. These rooms, dating from the third century, were hewn out of the highly consolidated pleistocene gravels (nagelfluh). In its physical character, this rock is apparently more ancient than some of the Cambrian and Ordovician beds in Northern Russia. (After Grabau.)

ber One well comprehended, that any kind of fossil whatever may occur next to the Archæan, or Primitive, and the rocky strata containing it may in texture and appearance "closely resemble some of the most ancient deposits on the globe," *where* on this broad earth shall we look for the place *to start* our life-succession? That is, where can we now go to find

those kinds of fossils which we can prove, by independent arguments, to be undeniably older than all others? Or how are we to be sure that when the so-called "oldest" types, let us say the Algonkian or Pre-Cambrian, were in existence in the Canadian Rockies of British Columbia and Alberta, this assemblage of life alone encircled the globe, and no other very diverse type was in existence anywhere on earth? It may seem very difficult for some of us to discard a theory so long an integral part of all geology; but until it can be proved that this "broad fact," as stated by Zittel and Dana, is no fact at all, I see no escape from the acknowledgment that *the doctrine of any particular fossils' being essentially older than others is a pure invention, with absolutely nothing in nature to support it.*

Or, to state the matter in another way: Since the life-succession theory rests logically and historically on the biological form of Werner's onion-coat notion that only certain kinds of rocks (fossils) are to be found at the "bottom," or next to the Archæan, or Primitive, and it is now acknowledged everywhere that any kind of rocks whatever may be thus situated, it is as clear as sunlight that the life-succession theory rests logically and historically on a myth, and that there is *no way of proving what kind of fossil was buried first.*

IV

Of course, the reason why the followers of Cuvier and his life-succession now find themselves in such a

predicament as this, is that they have not been following true inductive methods. Theirs has been a geology by hypothesis instead of by observed fact. They started out with a pretty scheme, ready made, about the origin and formation of the world, perfectly innocent of any evil intent in such a method of procedure, and unconscious of its speculative or subjective character; and for nearly a hundred years, they have supposed that they were following inductive methods in geology. But we now have plenty of scientific facts which should save the world from any further repetition of these follies.

In childhood and youth, when the glamour of novelty is upon everything we see and hear, how much enthusiasm we have in expressing our discoveries! but how inaccurate and how false are the judgments which we form, based on our scanty knowledge! It is the same exactly in the history of any science. Each science, too, has its enthusiastic youth, with theories unhampered by accurate and adequate information; and when the science finally reaches maturity, the facts which it has accumulated make its wild first youthful theories seem like childish nonsense.

Perhaps more conspicuously than any other of the sciences, geology exhibits these characteristics in its early history; but in its maturity, it has hitherto seemed to exhibit almost a case of arrested mental development.

All those childish assumptions about the fossiliferous strata really representing distinct ages in the world's history, which might seem pardonable in the

early geological explorers when their astonished eyes first gazed on the strange, outlandish-looking specimens found in the Wealden and the Flötz-gebirge, are quite out of place in this third decade of the twentieth century, when we have acquired so many facilities for an intimate acquaintance with all parts of that buried fossil world.

Macaulay remarks, regarding the contrast between the mythology of the early Greeks and the same absurd stories perpetuated by the later Greek philosophers:

> "Those unsuccessful attempts to articulate which are so delightful and interesting in a child, shock and disgust us in an aged paralytic; and in the same way, those wild mythological fictions which charm us when we hear them lisped by Greek poetry in its infancy, excite a mixed sensation of pity and loathing when mumbled by Greek philosophy in its old age."[12]

[12] "Essays," Vol. 2, p. 230.

CHAPTER IV

"Deceptive Conformity": Fact Number Two

I

If we had ample evidence that a certain man was personally acquainted with Julius Cæsar, that the two were born in the same town, went to school together, served in the same wars, and later carried on an extensive mutual correspondence, would we not conclude that they must have lived in the same *age* of the world's history? I confess that the conclusion seems quite unavoidable. Who would dream that nineteen centuries or so had separated the two lives, and that while one was an old Roman, the other was an American of the twentieth century?

Some such puzzle as this is presented in geology under the general subject of *conformity* or *conformability*. Let me define this term.

Strata laid down by water are in the first place in a horizontal position. Some subsequent force may have disturbed them; so that we may now find them standing up on edge like books in a library. But all human experience goes to show that they were not deposited in this position. Some disturbing cause must have taken hold of them since they were laid down, for the water in which they were made must have spread them out smooth and horizontal, each

subsequent layer, or stratum, fitting "like a glove" on the preceding. Thus when we find two successive layers agreeing with each other in their planes of bedding, with every indication that the lower one was not eroded or disturbed in any way before the upper one was spread out upon it, the two are said to be *conformable.* But if the lower bed has evidently been upturned or disturbed before the other was laid down, or if its surface has even been partly eroded or washed away by the water, the strata are said to be *uncomformable,* or they show *unconformity* in bedding.

Of course, in all this, we are dealing only with *relative* time. When we find one bed, or stratum, lying above another in their natural position, the lower one is, to be sure, the older of the two; but whether laid down ten minutes earlier, or ten million years earlier, how are we to determine? Ignoring the matter of the fossils they contain, must we not own that, though there is no way of telling just how long the lower one was deposited before the next succeeding, yet if the two are *conformable* to one another, and the bottom one shows no evidence of disturbance or erosion before the other was fitted upon it, the strong presumption would seem to be that *no great length of time* could have elapsed between the laying down of the two layers? To say that we have here a geological example similar to that of a modern American having been personally acquainted with Julius Cæsar, would seem to be quite inexplicable, to use Herbert Spencer's favorite word.

II

But if the life-succession theory be true, we have just such a conundrum in our Fact Number Two, which is that *any fossiliferous formation whatever may rest conformably upon any other "older" fossiliferous formation.*[1]

The lower may be Devonian, Silurian, or Cambrian, and the upper one Cretaceous or Tertiary; and thus, according to the theory, millions on millions of years must have elapsed after the first, and before the following bed was laid down. But the conformity is perfect, and the beds have all the appearance of having followed in quick succession. Sometimes, too, these age-separated formations are lithically the same, and can only be separated by their fossils! A still more amazing fact, from the standpoint of current theory, is that these conformable conditions are often *repeated over and over again in the same vertical section,* the same kind of bed reappearing alternately with other beds of an entirely different character; that is, a certain kind of fossiliferous stratum may be found *interbedded several times* in a manifestly undisturbed series of very different beds.[2] These things are a great puzzle to the believers in the successive ages, while they are perfectly intelligible to the advocates of inductive geology.

[1] Over three quarters of a century ago this principle was recognized. "I feel persuaded that there is no fact more clear in geology than this; namely, that the upper surface of almost every formation was yet soft and moist when the superincumbent sediments were deposited upon it." (Fairholme, "The Mosaic Deluge," 1837, p. 396.)

[2] See page 113, also pages 109-112 of this volume.

To describe this condition, where "young" strata occur conformably on much "older" strata, with nothing in the way of either erosion or disturbance to mark the great hiatus, or the lost interval, between them, geologists have coined the word *"disconformity,"* while some call it by the very expressive term *"deceptive conformity."*[3] Thus a disconformity, or a deceptive conformity, is a case where the rocks seem to have followed in quick succession. But the popular theory says, No; for the fossils in the lower beds belong in such-and-such an age, while the fossils in the upper beds belong in such-and-such an age, and a very long interval elapsed between these two ages, which is recorded in other rocks elsewhere, these other rocks from the other locality belonging in reality *in between* these two apparently conformable beds, though there is nothing here to indicate this great interval of time.

III

The literature really teems with illustrations of these facts, and the more detailed accounts contained in the various Geological Reports are often quite charmingly naïve in their description of the conditions. A few examples, however, must suffice.

The first is from the Report on the region about Banff, in Alberta, near the line of the Canadian Pacific Railway, on the edge of the Rockies:

"East of the main divide the Lower Carboniferous is overlaid in places by beds of Lower Cretaceous age, and here

[3] "Introduction," W. B. Scott, p. 380.

again, although the two formations differ so widely in respect to age, one overlies the other without any perceptible break, and the separation of one from the other is rendered more difficult by the fact that the upper beds of the Carboniferous *are lithologically almost precisely like those of the Cretaceous* [*above them*]. *Were it not for fossil evidence, one would naturally suppose that a single formation was being dealt with.*"[4]

Another example is from the District of Athabasca:

"The Devonian limestone is apparently succeeded conformably by the Cretaceous, and with the possible exception of a thin bed of conglomerate of limited extent, which occurs below Crooked Rapid on the Athabasca, the age of which is doubtful, the *vast interval of time which separated the two formations is, so far as observed, unrepresented either by deposition or erosion.*"[5]

In the former instance, we have Lower Cretaceous resting directly upon the Lower Carboniferous, the Upper Carboniferous, the Permian, the Triassic, and the Jurassic being absent. In the second instance, we have the entire Carboniferous, the Permian, the Triassic, and the Jurassic absent, the strata appearing exactly as if all these "ages" had never existed in these localities.

Some geological writers labor to explain this thundering rebuke of their theory, just as the Ptolemaic astronomers had their "deferents" and "epicycles" for every new difficulty. But surely the detailed records of such observations as these are fearful examples of the power of tradition to blind the minds of investigators to the meaning of the very plainest facts.

[4] Canadian "Annual Report," New Series, Vol. 2, Part A, p. 8.
[5] Id., Vol. 5, Part D, p. 52.

On a previous page[6] the author last quoted gives us some idea of the "remarkable persistence" of this instructive case of conformity, which extends from the Athabasca "in a broad band around the southern end of Birch Mountains, and across Lake Claire to Peace River, and up the latter stream to a point two miles above Vermillion Falls."

The distance, as I judge from the map, can not be less than 150 miles in a straight direction, thus making a district of probably several thousand square miles in extent where, according to the theory of a life-succession, nature must have served an injunction on the action of the elements, and they had to continue in the *status quo* for millions of ages, or from the Devonian to the Cretaceous "age," the water neither wearing away nor building up over any part of this taboo ground during all this time. No wonder Suess says that such things "may well be cause for astonishment."[7]

Nor is this all; for in this same Report,[8] we are told of strata near Lake Manitoba, over 500 miles away, in almost the same wonderful relationship,—"Devonian rocks very similar in character" to those in Athabasca still overlaid directly by the Cretaceous, though, in this case, as it happens, "unconformably." It would almost seem to be a *bona fide* case of Werner's onion-coats cropping out.

And all this incredible picture of nature's inconsistent behavior in past ages is necessitated solely

[6] Id., p. 51.
[7] "The Face of the Earth," Vol. 2, p. 543.
[8] Canadian "Annual Report," Part E, p. 209.

by the loving allegiance with which the infallibility of the life-succession theory is regarded by modern geologists.[9]

We have space for only a few more such cases of "deceptive conformity."

In the Bear Grass quarries at Louisville, Kentucky, a coral limestone, classed as Middle Devonian, occurs directly upon an almost exactly similar-looking coral limestone which, because it carries different fossils, is classed as Middle Silurian. And yet "the absolute conformability of the beds can be traced for nearly a mile," and "the parting between these two zones is like that between any two limestone beds; but this insignificant line represents a stratigraphic hiatus the equivalent of the last third of Silurian and the first third of Devonian time."[10]

How many million years this represents, in the terms of the evolutionary scheme, it would be hard to state, as the length of time which is involved in one of these geologic systems is not at all agreed upon.

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[9] In the earlier and more rational days of geology, many writers used to remark how all the fossiliferous deposits were closely connected with one another, while being everywhere unconformable to the Archæan, or the Primitive, and also unconformable to the Recent. De la Beche and Phillips may be especially mentioned in this connection. Another geological writer, Dr. George Young, author of "A Geological Survey of the Yorkshire Coast," in a paper communicated to the Geological Section of the British Association, 1838, remarks: "In fact, although in describing them we may distinguish a succession of deposits, they are so connected together as to form one whole,— one grand deposit; leading us to conceive that *one age* might give birth to the entire series. . . . However numerous the beds, and however we may attempt to subdivide them, they are but parts of the same whole; and instead of being very slowly formed during a long succession of ages, *they bear the marks of having been deposited about one period.*"

[10] "Textbook," Schuchert, pp. 587, 588.

Fig. 21. View in Shanks quarry, on Bear Grass Creek, near Louisville, Kentucky. Looking southeast. Here Middle Devonian strata rest in "deceptive conformity" upon Middle Silurian, the contact line being in the upper heavy layer, just above the white streaks, which are light-colored chert in the Silurian part of the layer. (Butts, U. S. G. S.)

But it would undoubtedly be a very great period, to say the least.

A very similar case of Middle Devonian resting conformably upon Middle Silurian, is seen at Newsom, Tennessee. If we could only be permitted to suppose these conditions to be continuous beneath the surface over all the intervening distance between this case in Tennessee and the one exactly like it at Louisville, just mentioned, a distance of some 200 miles, we

FIG. 22. Close view in Shanks quarry, showing the "deceptive conformity" between the Middle Devonian above, and the Middle Silurian below,—marked by the hammer head. Looking east. (Butts, U. S. G. S.)

should not be exceeding probability in the least, and would also have an abundance of geological precedent on our side; for geologists almost always assume a continuity of the beds which occur thus in two neighboring outcrops.

This latter case, however, has an additional interest, in that another deceptive conformity is seen above these Middle Devonian beds, which are only about six feet thick, these being capped conformably by Mississippian (Lower Carboniferous) shales, the Upper Devonian being absent. Thus we have a double ex-

ample of deceptive conformity in this same vertical section. It is as if some modern American were personally acquainted with Julius Cæsar, and the latter, in turn, were personally acquainted with Menes or Hammurabi.

A somewhat similar double case of disconformity occurs at Buffalo, New York, the upper of the two being where the Onondaga (Middle Devonian) rests conformably on the Manlius (Upper Silurian), the Lower Devonian being absent. The second disconformity in this same section is a few feet lower down, and a considerable part of the Silurian is missing.

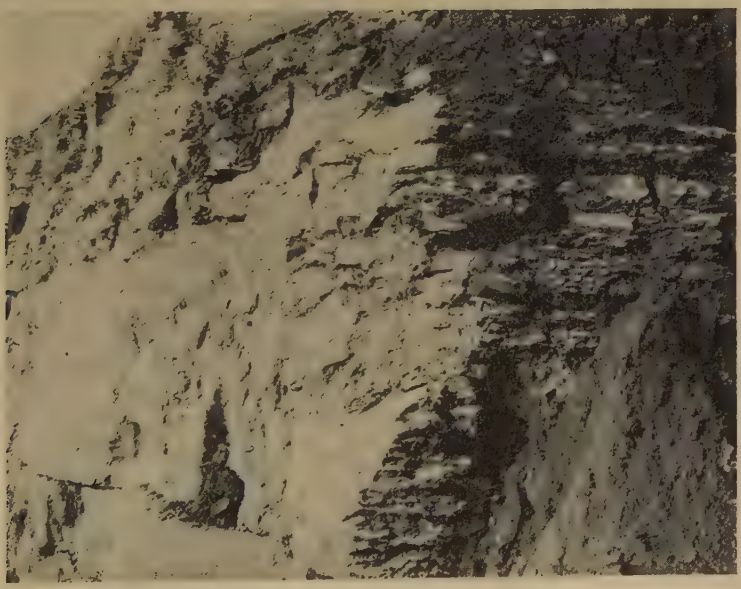


Fig. 23. Another view in Shanks quarry, as in Fig. 22, showing the contact of the "deceptive conformity," at the head of the hammer. (Butts, U. S. G. S.) Does it look as if several million years had elapsed between the two successive strata at the head of the hammer?

FIG. 24. A case of "deceptive conformity." Jeffersonville limestone (M. Devonian) is seen resting conformably upon Louisville limestone (L. Silurian). The hammer head, just below the hat, marks the line of contact. *Halysites cantenulatus*, characteristic of the lower Silurian, is found at the level of the hammer head, with abundant corals, *Favosites and Cyathophylloids*, in immediate contact with them above, and characteristic of the Middle Devonian. (Butts, U. S. G. S.)

Throughout a large part of eastern Tennessee, the Chattanooga black shales (Lower Carboniferous) rest conformably upon the Rockwood gray clays (Lower Silurian), the whole of the Devonian and the upper half or more of the Silurian being absent. This example is further complicated by the fact that the two formations seem really to interfinger, or to be intercalated, with one another at the point of contact, so

that it is difficult to tell just where to draw the line between them.

"Throughout northeastern China, in the provinces of Chihli, Shansi, Shantung, and Honan, there is an unconformity [disconformity] which brings the Ordovician in contact with the Carboniferous. . . . The hiatus appears, therefore, to represent later Ordovician, Silurian, Devonian, and Lower Carboniferous times. Local observations all agree that the Ordovician and the Carboniferous strata are strictly conformable; so closely parallel are they that Von Richthofen, who repeatedly saw the contact, assumed that they formed an unbroken sequence."[11]

I do not think that any comment of mine is necessary in this instance. In the number of geological "ages" that are missing, this case from China almost equals the case from Russia, which has been a classic in geological literature ever since the days of Murchison, who first reported it. This latter is on the Dwina, in northern Russia, where Pleistocene beds occur in "absolutely conformable superposition on the horizontal Permian sediments."[12]

IV

We have not space for further listing of specific examples, but must content ourselves with some general statements on this point culled from the standard literature of the science.

Thus as long ago as the date of the publication of "The Origin of Species," Darwin, in speaking of the "imperfection of the geological record," could speak of "the many cases on record of a formation *con-*

[11] "Research in China," Bailey Willis, Vol. 2, p. 67.
[12] "The Face of the Earth," Suess, Vol. 2, p. 543.

formably covered, after an immense interval of time, by another and later formation, without the underlying bed's having suffered in the interval by any wear and tear."[13]

Also Geikie, in speaking of how "fossil evidence may be made to prove the existence of gaps which are not otherwise apparent," says that "it is not so easy to give a satisfactory account of those which occur where the strata are strictly conformable, and where no evidence can be observed of any considerable change of physical conditions at the time of deposit. A group of *quite conformable strata having the same general lithological characters throughout,* may be marked by a great discrepance between the fossils of the upper and the lower part." In many cases, he says, these conditions are *"not merely local,* but persistent over wide areas. . . . They *occur abundantly* among the European Paleozoic and Secondary rocks," and are "traceable over wide regions."[14] Indeed, one of the most experienced paleontologists in America has told the present writer that he himself has probably seen and examined a thousand examples of this character, some of them covering areas equal to one or more states.

We have seen how Dana admits that "a stratum of one era may rest upon any stratum in the whole series below it, . . . the intermediate being wanting." He classes this under the head of the *"difficulties"* of the science, quite naturally, as it would seem,

[13] "Origin," 6th ed., Vol. 2, p. 58.
[14] "Textbook," p. 842.

though he does not expressly assert that these age-separated formations are often conformable to one another, as Geikie and Darwin have said in the quotations given.

Suess, however, is much more explicit, for he declares that there are "numerous examples" of "*concordant* superposition of the more recent beds on those of much greater age." We need not reproduce the specific examples he mentions, and need only quote his remark that comparatively "young" rocks often "rest in perfect concordance on much older beds, so that the stratigraphical relations offer *no hint of the great gap* which occurs at the line of contact."[15] All of which, he says, "may well be cause for astonishment."

Dr. E. O. Ulrich also has given us some general remarks regarding the phenomena which we are here discussing, his remarks, of course, having particular reference to conditions here in America. He says:

"A break corresponding to several geological periods may be no more clearly marked than the relatively brief interruption of sedimentation between two small formations, or between diastrophically distinguished members of a single formation. In fact, in equally good exposures, it is more difficult to detect the contact between Lower Pennsylvanian and Ozarkian [Lower Ordovician] sandstones in the vicinity of Bolivar, Missouri, than to find the boundary between the Jefferson City and the Yellville, in Arkansas, or the sharp line between earlier and later limestones in the Black River group at many places in the Mohawk Valley in New York. *It makes little difference whether the compared sequences are lithologically*

[15] "The Face of the Earth," Vol. 2, p. 543.

similar or dissimilar; the large hiatuses are, as a rule, no more clearly defined than the small breaks.''[16]

V

What more need be said on this subject of ''deceptive conformity''? I have not, of course, proved every possible combination of ''younger'' strata occurring conformably on much ''older'' strata, as is stated in the earlier part of this chapter as my Fact Number Two. But no scientifically trained person will think of quibbling over such a point as this. We have had plenty of examples to establish this as a great stratigraphical law, that any sort of fossiliferous strata may be found occurring on any other ''older'' formation, with every physical appearance of perfect conformity, just as if all the numerous formations or groups of formations alleged to be properly intervening between them *never existed.* And I will certainly have ''cause for astonishment'' if this one stratigraphical law is not sufficient to destroy the entire value of the geological series as a scientific statement of a real historical sequence.

Either this law, stated above as Fact Number Two, is false, or the traditional geological series must mean something else than a real historical series. But since the latter is only a theoretical idea to begin with, I do not see how such an inadequate theory can possibly endure in the face of such facts as have been given above.

[16] Bulletin of the Geological Society of America, Vol. 22, p. 459.

CHAPTER V

Upside Down: Fact Number Three

I

It is a law of the human mind, that in all scientific inquiry we generally find what we are looking for; in other words, nature will answer us only when we put to her *leading* questions, or when we shape our questions so they can be answered by *yes* or *no*. "Nature," says Sir E. Ray Lankester, in his essay on "Degeneration," "gives no reply to a general inquiry — she must be interrogated by questions which already contain the answer she is to give; in other words, the observer can only observe that which he is led by hypothesis to look for."

For nearly a hundred years, the rocks in all parts of the world have been interrogated in the terms of a single theory; and since this theory has been treated constantly as an axiomatic fact which it would be folly to question or disregard, an affirmative answer has always been extracted from the rocks sooner or later; though often the methods employed to elicit such an answer remind us very much of those employed in other days to get the desired answer from obstinate heretics.

II

Every student of mountain structure becomes impressed with the mighty forces that have acted upon

the strata in folding, twisting, and contorting them. But often the interpretation of the record has been made unnecessarily complicated and even incredible by an attempt to make the beds confirm this pre-arranged order in which it was supposed they must occur. Thus when we are told by a standard authority like Dana, that one of the great folds of the Alps "has put the beds upside down over an area of 450 square miles,"[1] we very naturally ask, What evidence is there of such an awful and incredible catastrophe? Most of the folds in the mountains which we can really follow up and trace out in detail are to be measured in feet and yards, not in miles or geographical degrees. Ought we not to expect and to demand the most positive evidence if we are to believe that old Mother Earth ever turned such a huge calcareous and siliceous pancake as this describes? In other words, while every intelligent man knows that the rocks have in many instances been tilted up at various angles or perhaps even overturned over a few square feet, yet the thickness of the strata thus involved and the size of the folds thus made, are in all cases so inconsiderable that the unsophisticated man is compelled to look with suspicion on statements like this that speak of a whole country's being found upside down; and his incredulity is not at all diminished when he finds that in such instances, the only evidence we have of such an astonishing event is that the strata are here in the "wrong" order, the "older" fossils being on top, and the "younger" ones underneath, over these immense tracts of country.

[1] "Manual," p. 367.

III

But let us retrace our steps somewhat, and pick up the thread of our main argument. We have already found quite serious reason to question the truthfulness of the alleged "invariable" order in which the rocks occur. But there is still another way of testing the rationality of this life-succession idea and this alleged "invariability" of the order of the fossils. If certain fossils are not necessarily older than certain others, it might reasonably be expected that we would now and then find them reversed as to position; that is, with the "younger" below and the "older" above. Accordingly, we have the following very necessary caution from Professor Nicholson:

"It may even be said that in any case where there should appear to be a clear and decisive discordance between the physical and the paleontological [fossil] evidence as to the age of a given series of beds, it is the former that is to be distrusted rather than the latter."[2]

Humorous?—Not at all; the theory requires it, and therefore quite soberly we are told, in effect, that *since* the fossils always occur in an invariable relative order of succession, *therefore,* whenever we find them in the *reverse* order, we must distrust the positive evidence of all our senses, and say that somehow the "older" beds have been put on top by some great disturbance, and those below are really "younger," but in the wrong position. The real humor of the situation is that this method of reasoning has been literally and consistently carried out by all evolu-

[2] "Ancient Life History of the Earth," p. 40.

tionary geologists for more than half a century. If there is anything in the history of human thought to equal this, I do not know what it is.

To meet all ordinary cases of this character, where the differences involve only a few horizons, representing only a few formations, or a mere fraction of

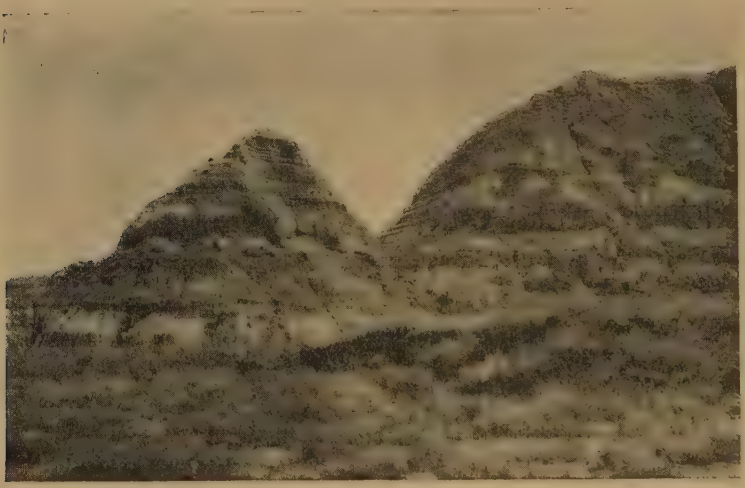


FIG. 25. Lance formation, as seen near Wade, North Dakota. Geologists have long been in perplexity as to how these beds ought to be classified; since they contain fossils which seem to be "younger" than the fossils in the beds stratigraphically above them. (Stanton, U. S. G. S.)

the total of "geological time," the theory of pioneer "colonies" was invented by Barrande in 1852. Ten years later appeared Huxley's famous essay on "Homotaxis," already quoted in Chapter I; but this, instead of pointing the way for a complete reconstruction of geological theory, as it ought to have been allowed to do, seems only to have been used to help

explain away the troublesome evidence in such upside-down conditions as the Pikermi beds in Greece, which contain typical Miocene types, but rest on late Pliocene strata; or the Gondwanas of India, which contain a Triassic flora, but overlie a Jurassic flora, with a Triassic fauna above both; or the Newcastle beds in Australia, where a Jurassic flora is inextricably mixed up with a Lower Carboniferous fauna, with Permian beds over all; to say nothing of many cases nearer home, such as the Lance formation of the plains region of North America, where fossil plants that ought to be classed as Tertiary have an undisputed Cretaceous fauna above them; or the Anderdon limestones of Michigan, Ohio, and Ontario, which contain an extensive "pioneer colony" of Middle Devonian fossils interbedded with Silurian strata. Such, however, are only the ordinary and quite minor difficulties of the theory, encountered in every considerable region yet penetrated by geological exploration.

The many instances of what are termed "recurrent faunas" may be briefly mentioned here. These are instances where what are termed "emigrant" groups or faunas recur over and over again, interbedded among formations classed as distinctly different in point of "age." H. S. Williams was the first to call attention to these examples of "recurrent faunas." When he first began his scientific work, it was a cardinal doctrine among geologists that a distinct set of fossils always characterizes each geological horizon or formation. But he soon learned that there are important exceptions to this rule. As

his biographer relates, "In studying the Devonian formations about Ithaca, he found that the so-called characteristic fossils of the Hamilton formation, for example, also occur in certain beds in the Ithaca; that in the Ithaca group there is 'first a Portage fauna; then the Ithaca fauna; third, the Portage fauna again; and finally, the Chemung capped by the Cats-

FIG. 26. Lance formation (Cretaceous?). On Cannonball River, North Dakota. (Lloyd, U. S. G. S.)

kill and Carboniferous.' This discovery, fundamental as it is, was not immediately welcome to all paleontologists, because, as one said, 'How is one to be sure of the age of any formation, if one can not depend upon the characteristic fossils?'"

E. O. Ulrich gives a list of several of the more famous examples of these "recurrent faunas" here in America, one of which had *three* recurrences, another

two, and another *five;* and he raises the very natural query whether the time-value of fossil evidence has not been very seriously impaired by these phenomena. He manages to patch up a *modus vivendi* between these facts and the traditional theory; but it seems to me that even such examples as these of the fossils occurring in the "wrong" order, ought to give pause to the confident assertions that the fossils always occur in the same relative order of sequence, and that this order is never reversed.[3]

But for more extreme cases, say, where Cambrian or other Paleozoic fossils occur on top of Jurassic, Cretaceous, or Tertiary, there is in such a predicament always an anxious search made for faults and displacements; and if others are not to be found, the stratification planes separating the beds are called "faults," and then we are confidently told that immense mountain masses, perhaps covering thousands of square miles, have been pushed up on top of the younger rocks, where they now lie in what looks exactly like a normal position, with nearly horizontal stratification. Albert Heim of Switzerland was perhaps the first to teach the scientific world to speak of huge "overthrust folds," mapping them out with imaginary arcs of circles miles high in the air as the place where these folds once were; and such explanations are not yet entirely discarded. But of late years, the theory of "thrust faults," with the mountains pushed bodily up on top of the other strata, has become the more popular method of

[3] "Revision of the Paleozoic Systems," E. O. Ulrich, in Geological Society of America Bulletin, Vol. 22 (1911), pp. 298, 299.

explanation, and there is scarcely an artificial geological section made within recent years that does not contain one or more of these "thrust faults," or "thrusts."[4] But the really important thing to remember in this connection is that it is *solely because the fossils are found occurring in the wrong order of sequence* that any such devices are thought to be necessary,—devices which, as has already been suggested of similar expedients to explain away evidence, deserve to rank with the famous "epicycles" of Ptolemy, and will do so some day.

Here is Geikie's amazing style of argument to prove the reality of such great earth movements:

> "We may even demonstrate [?] that in some mountainous ground the strata have been turned completely upside down *if* we can show that the fossils in what are now the uppermost layers *ought properly* to lie underneath those in the beds below them."[5]

Some day, I fancy, such a statement will be regarded as one of the curiosities of the history of scientific theories. But this is no isolated expression wrested from its context; it is the fundamental method employed in all modern geological investigation, and well illustrates what Sir Henry Howorth calls the "singular and notable fact that, while most other branches of science have emancipated themselves from the trammels of metaphysical reasoning, the science of geology still remains imprisoned in '*a priori*' theories."[6]

[4] See Fig. 46.
[5] "Textbook," ed. 1903, p. 837.
[6] "The Glacial Nightmare," Preface, p. 7.

This language from Geikie is in perfect accord with that already quoted from Nicholson, where the latter says that whenever there is a clear and decisive disagreement between the physical evidence and that furnished by the fossils, "it is the former that is to be distrusted rather than the latter."

Readers of these extracts who have been trained in physics or chemistry, in astronomy or mathematics, or indeed in any other mental discipline whatever, will quite appreciate the remark which we frequently hear from geologists, that their science has its own standards of proof and its own methods of reasoning. And we can quite understand why geologists resent any interference with their methods by "outsiders."

Here is another statement of the same general import, taken from this standard textbook by Geikie, regarding some conditions in the Alps:

> "The strata could scarcely be supposed to have been really inverted, save for the evidence[?] as to their true order of succession supplied by their included fossils. . . . Portions of Carboniferous strata appear as if regularly interbedded among Jurassic rocks, and indeed could not be separated save after a study of their inclosed organic remains."[7]

Plenty of striking examples of such alleged upside-down conditions have come to light in recent years; but we have here room for the details of only one or two. But these are typical of the rest; and I believe they are quite sufficiently obvious in their meaning to prove that the rocks were really laid down in the order in which we now find them.

[7] "Textbook," p. 678.

IV

The first instance is from a part of Alberta just east of the Rocky Mountains, where the Canadian Pacific Railway enters the foothills.[8] Here the whole of the Fairholme Mountain, east of Banff and north of the railway and the Bow River, consists of Cambrian limestones, yet they rest apparently conformably on Cretaceous shales. R. G. McConnell of the Canadian Survey, who first described it, remarks with amazement on the way in which the line of separation between the shales and the limestone,—what the current theory is compelled to call the "thrust plane,"—resembles in all respects an ordinary stratification plane. He says:

"The angle of inclination of its plane to the horizon is *very low,* and in consequence of this its outcrop follows a very sinuous line along the base of the mountains, *and acts exactly like the line of contact of two nearly horizontal formations.*

"The best places for examining this fault are at the gaps of the Bow and of the south fork of Ghost River. At the former place the Cretaceous shales form the floor of the bay which the Bow has cut in the eastern wall of the range, and rise to a considerable height in the surrounding slopes. Their line of contact with the massive gray limestones of the overlying Castle Mountain group is well seen near the entrance to the gap in the hills to the north. The fault plane here is nearly horizontal, and the two formations, viewed from the valley, *appear to succeed one another conformably.*"[9]

This author further declares that the underlying Cretaceous shales are "very soft," and "have suffered little by the sliding of the limestone over them."[10]

[8] See Frontispiece.
[9] "Annual Report," 1886, Part D, pp. 33, 34.
[10] Id., p. 84.

But what an amazing condition of affairs is this! Here are great mountainous masses of rocks, very similar in mechanical and mineral make-up to thousands of examples elsewhere. The line of bedding between them "acts exactly like the line of contact of two nearly horizontal formations"; and in a natural section cut out by a river, the two "appear to succeed one another conformably." Yet we are asked to believe that all this is merely an optical illusion. The rocks could not possibly have been deposited in this way, for the lower ones contain "Benton fossils" (Cretaceous), and the upper ones are Cambrian, and almost the whole geological series and untold millions of years occurred after the upper one, and before the lower one was formed. *Solely on the strength of the*

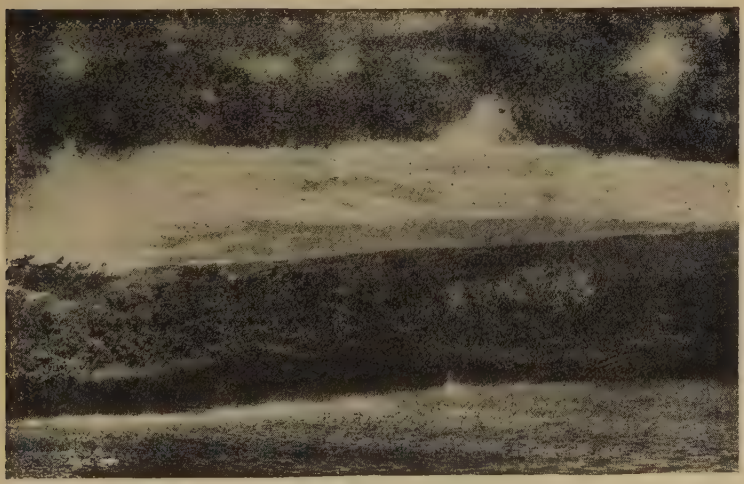


Fig. 27. Panorama showing Chief Mountain and neighboring peaks. All the foreground and the bases of these mountains are Cretaceous. The tops of the mountains are composed of Algonkian limestone. (Willis, U. S. G. S.)

(Photograph by Rollin T. Chamberlin)

FIG. 28. Cambrian limestone resting on Cretaceous shale, looking north from near Kananaskis Station, Alberta. This is the eastern part of the great mountain mass that the theory says has been pushed up into its present position, though the limestone rests on the shale conformably, as described in the text.

infallibility of a theory invented a hundred years ago in a little corner of western Europe, which "promulgated, as respecting the world, a scheme collected from that province," and assumed that over all the world, the rocks must always follow the order there observed, we are here asked to deny the positive evidence of our senses, BECAUSE *these rocks do not follow this accepted order.* I must confess that I can not see the force of such a method of reasoning. It is carrying the argument several degrees beyond the reasoning of the three little green peas in the little green pod, as narrated in the exquisite fable of

Eugene Field. These wise little fellows noticed that their little world was all green, and they themselves green likewise, and they shrewdly concluded from this that the whole universe must also be green. But we are not told of their traveling abroad and persisting in a systematic attempt to explain all subsequently observed facts in terms of their theory.

The accompanying photograph (Fig. 28), which shows a part of this Fairholme Mountain as viewed from near Kananaskis Station on the railway, is supplied by courtesy of R. T. Chamberlin of the University of Chicago, who examined this region in the summer of 1910, and who says that he found "what appears to be a continuation of this same

Fig. 29. Crow's Nest Mountain, from near Coleman, Alberta. The jointed, precipitous part of the mountain is composed of Paleozoic limestone, resting on Cretaceous sandstones. This mountain has an elevation of 9,125 feet, or about 4,800 feet above the valley. It is situated some twenty miles west of the front range of the Rockies at this point. According to the popular theory, all this region of Paleozoic strata was pushed bodily over on top of the Cretaceous.

FIG. 30. Chief Mountain, Montana, looking north from Kennedy Creek. This mountain is situated some three miles south of the international boundary line. Its top is composed of Algonkian limestone and quartzite, which rest on Cretaceous shales, with every physical appearance of natural conformity. (Stanton, U. S. G. S.)

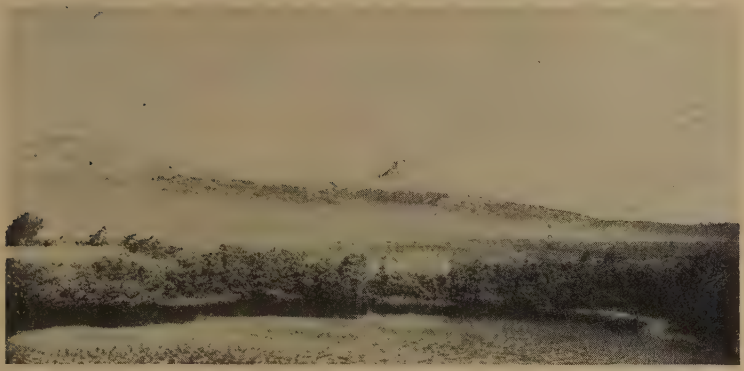


Fig. 31. Panorama showing Chief Mountain and neighboring peaks, Montana. The caps of these mountains (Algonkian limestone) evidently once extended far out beyond where we find this rock at present; the rest has been eroded away. Yellow Mountain on the left. (Willis, U. S. G. S.)

thrust plane a hundred miles farther south, on the Crow's Nest branch of the Canadian Pacific Railway." Thus, according to the common theory, this whole region of country must have been pushed bodily forward for a distance of many miles to get these rocks into their present position.

But before describing this area in detail, we must go some fifty miles still farther south of Crow's Nest Mountain, or over a hundred and fifty miles south of the mountain described above by McConnell, to a region in northern Montana, a map of which is given in Fig. 36. The light part of this map represents the Cambrian or Pre-Cambrian rocks, which, according to the theory, have also been pushed bodily for many miles over on top of the Cretaceous shales, represented by the darker portion. The accompanying photograph of Chief Mountain (Fig. 30), which stands

somewhat alone just south of the 49th parallel, gives a typical view of these two sets of rocks, and shows how much more natural it would be to think that these rocks represent a normal stratigraphical order than to imagine such a gigantic earth movement as the theory demands. Fig. 39 shows the appearance of other mountain masses in this same general area; and these mountains also must have been part of this great mass pushed forward over the Cretaceous.

Space forbids us to quote at length from the very interesting paper of Bailey Willis,[11] from which this

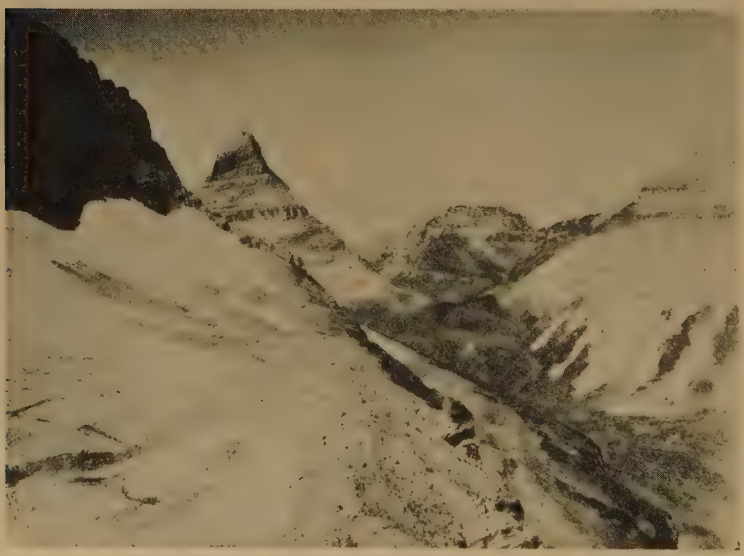


FIG. 32. Head of middle fork of Belly River, Glacier National Park, Montana. Looking northwest, with Sheppard Glacier in the left foreground. (Campbell, U. S. G. S.)

[11] Bulletin Geological Society, Vol. 13, pp. 305-352.

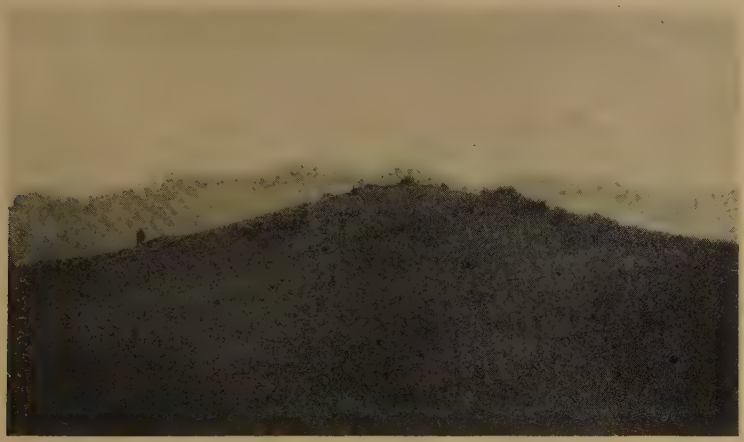


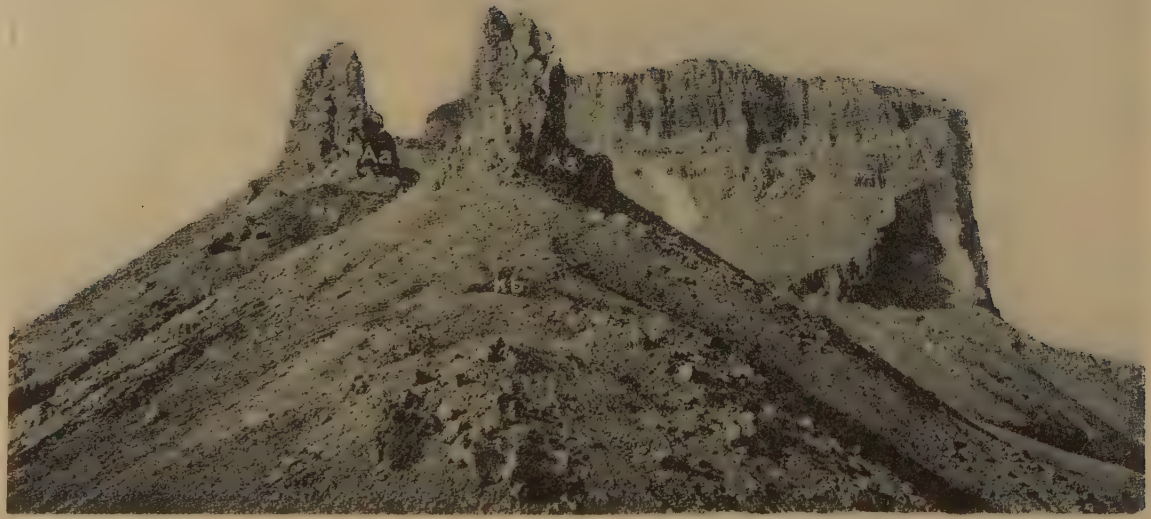
FIG. 33. Erosion remnant of Madison limestone (Mississippian or L. Carboniferous) resting in an apparently normal position upon Bridger beds (Middle Eocene), on East Peak, McCulloch's Peaks, Bighorn Basin, Wyoming.

map and some of the accompanying photographs are taken. He estimates that the Cretaceous rocks underneath the top of Chief Mountain are 3,500 feet thick; while the so-called thrust plane, he says, "is essentially parallel to the bedding" of the upper series.[12]

"This apparently is true not only of the segments of thrust surface beneath eastern Flattop, Yellow, and Chief Mountains, but also of the more deeply buried portion which appears to dip with the Algonkian strata into the syncline. While observation is not complete, it may be assumed on a basis of fact that thrust surfaces and bedding are nearly parallel over extensive areas."[13]

A further interest attaches to this region from the fact that it contains the main continental divide between the Atlantic and Pacific Oceans, as well as

[12] Id., p. 336.
[13] Ibid.



(From Bailey Willis, Bull. Geol. Soc. Am., Vol. 13, 1901)

FIG. 35. Looking east along Chief Mountain Ridge. Aa, Algonkian limestone; Kb, Cretaceous—Benton shale. This mountain, which is situated almost on the boundary line between the United States and Canada, is merely a little outlier of a large tract of country nearly 500 miles long by 20 or 30 miles wide, extending from the Yellowhead Pass, Alberta, to the Sun River Cañon, west of Great Falls, Montana. Over all this region, the tops of the mountains consist of this same sort of Algonkian (Paleozoic) limestones, resting in a perfectly natural manner, often conformably, on Cretaceous shales. Over how much more of the earth's surface would we have to find the rocks in this "upside-down" order before scientific men would acknowledge that the geological "ages" are only a big blunder, and the whole evolution theory a piece of elaborate nonsense founded on a blunder?

between Hudson Bay and the Gulf of Mexico; for streams from this region join the Saskatchewan, the Missouri, and the Columbia Rivers. *Thus the very roof of North America consists of a cap of Algonkian or Pre-Cambrian limestone resting in what looks like a perfectly natural way on Cretaceous beds.* The area shown on the map on page 124 is nearly thirty miles from north to south, but the region thus affected really extends considerably farther south;[14] while, instead of the seven miles spoken of by McConnell, which is given as the "displacement" that has been "observed," Willis says that "an equivalent amount" of movement underground must be taken into consideration.[15] Marius R. Campbell of the Washington Survey Staff, who visited this region in the summers

FIG. 34. Camp and lake in the cirque at the head of the North Fork of Cutbank Creek, Glacier National Park, Montana. (Stanton, U. S. G. S.)

[14] See F. H. H. Calhoun, Professional Paper No. 50, p. 10.
[15] Bulletin Geological Society, Vol. 13, page 341.

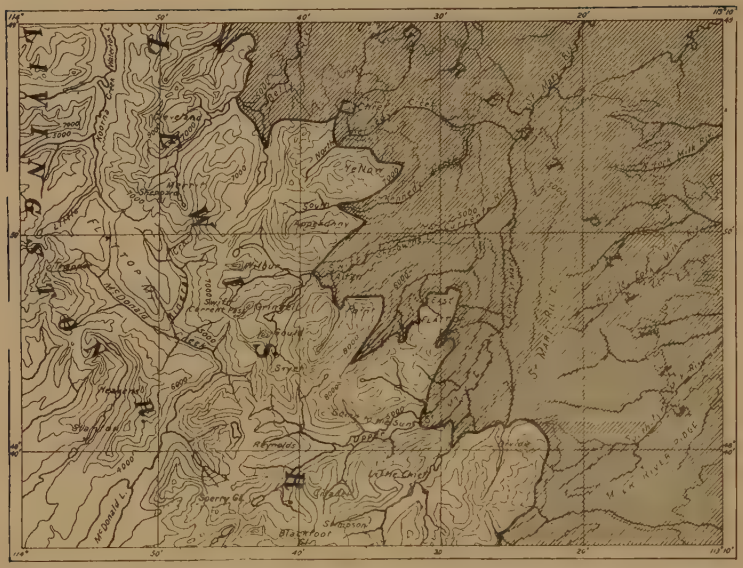


FIG. 36. Map of Great Plains and front ranges, northwest Montana. (Reduced from Browning and Chief Mountain atlas sheets, U. S. Geological Survey.) Shaded area, Cretaceous rocks; white area, Algonkian rocks. According to the current theory, all these Algonkian or Pre-Cambrian rocks must have been pushed up on top of the Cretaceous.

of 1910 and 1911, reports positive evidence that this great "over-thrust" is "not less than fifteen miles" from east to west, "almost every foot of which is clearly exposed."[16]

But all this is only the beginning of the story. We must return to the north, to note again the Crow's Nest Mountain, which G. M. Dawson of the Canadian Survey says "in its structure and general appearance much resembles Chief Mountain,"[17] its summit consisting of this same type of limestone, "in

[16] Letter to the author.

[17] Annual Report, 1885, Part B, p. 67.

a nearly horizontal attitude," resting on the Cretaceous. (See Fig. 35.) And it is this region that Professor Chamberlin says "appears to be a continuation" of the thrust plane a hundred miles farther north, described by McConnell.

V

We have now seen the characteristic features of this vast area, north, and south, and near the middle, though it really extends another hundred miles farther north, as we shall presently see. Parts of the intervening area are not yet (1925) well explored; but so far as it has been examined, the same conditions

Fig. 37. Panorama from Summit Mountain, looking down the middle fork of Belly River. Mt. Cleveland in the distance on the left. Glacier National Park, Montana. All of this region is composed of Algonkian rocks, and is a part of the vast region which, according to the current theory, has been pushed bodily over on top of the Cretaceous. (Campbell, U. S. G. S.)

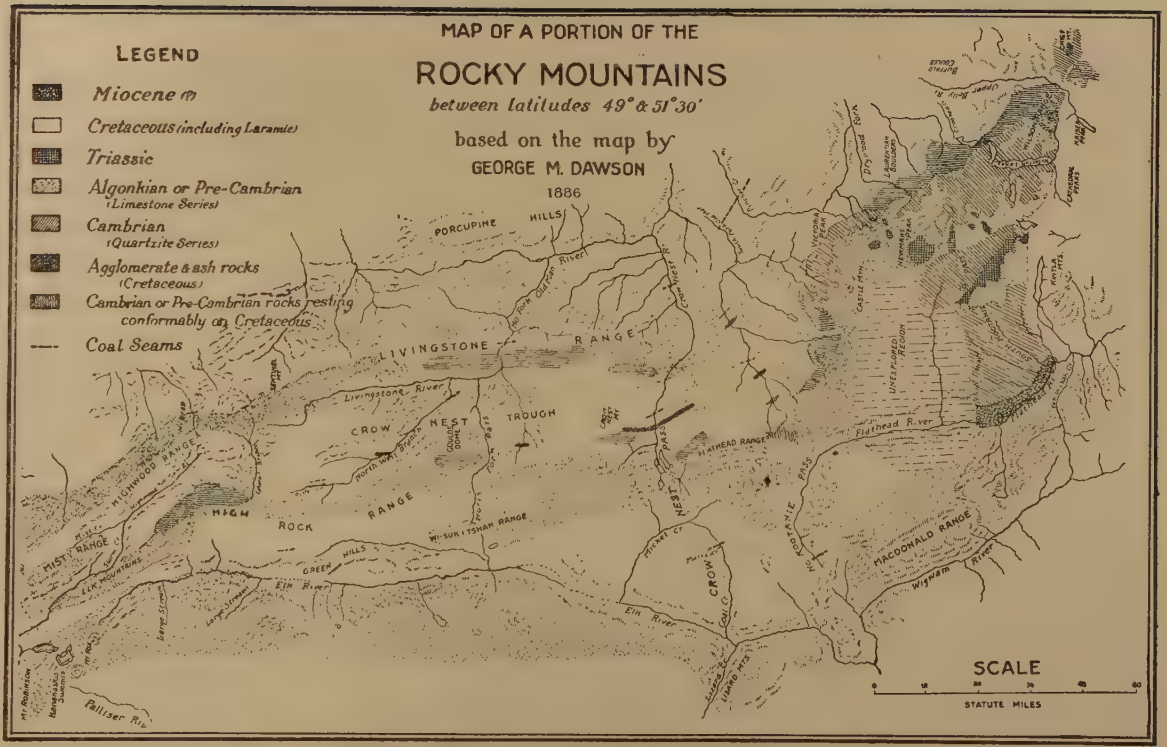
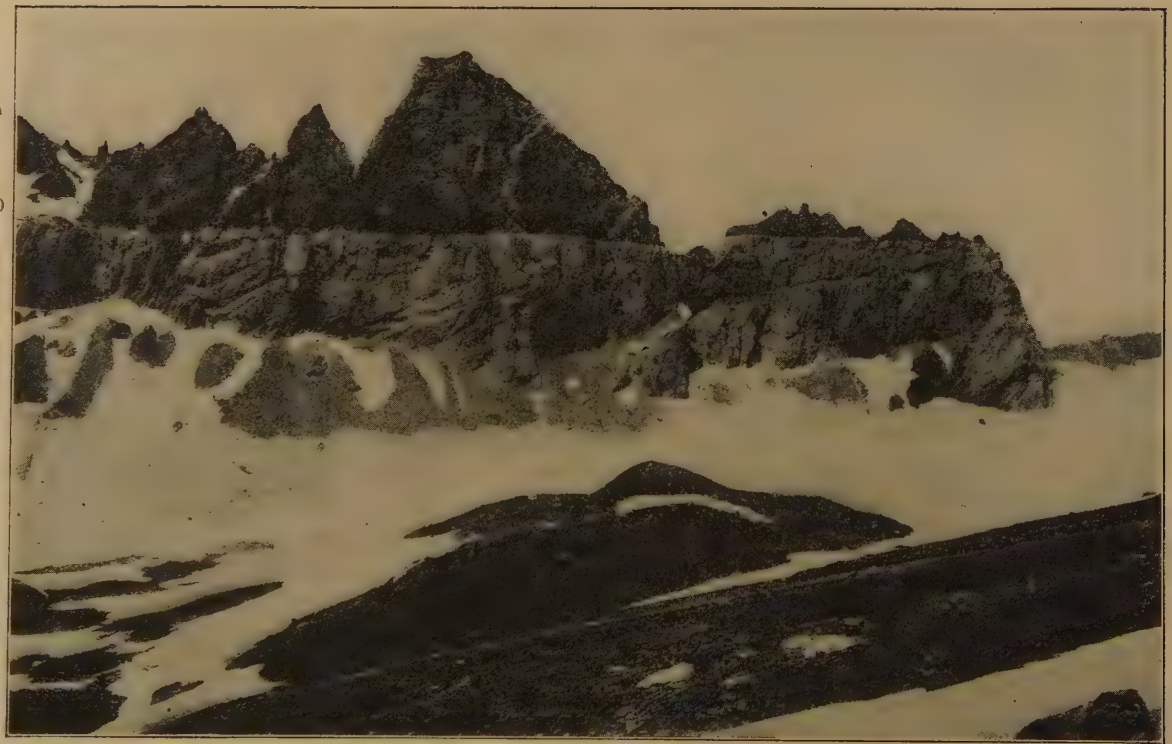


FIG. 38. NOTE.— As shown in the text (Chapter 5), similar conditions extend south to the middle of Montana, and north to the Yellowhead Pass. Over all this vast area the mountains consist of Pre-Cambrian and Paleozoic limestones and quartzites resting on soft Cretaceous shales, etc. They are usually horizontal, and, as indicated on the map, in many localities there are excellent exposures where the two formations *"appear to succeed one another conformably."* (McConnell.) How can the current theories be true in view of these facts?

are found to prevail. The very same lithological and geological structures recur over all this region with the persistence of a repeating decimal. The tops of the mountains, often their entire masses, consist of the same jointed limestones and argillites, like the

Fig. 39. North side of Swift Current Valley near Altyn, Montana, looking east. Typical Altyn Limestone cliff (Algonkian), overlying Benton (Cretaceous) shale. Though these rocks seem to be in a perfectly normal position relative to one another, the theory demands that the upper rocks must have been pushed up on top of the lower.

tops of Chief and Crow's Nest Mountains, which, by the erosion of the soft underlying shales, are left standing in rectangular, cathedral-like masses, easily recognizable as far off as they can be seen. And all around these Cambrian or Pre-Cambrian limestone mountains, wherever the rivers have eroded



(Courtesy of Dr. Albert Heim)

FIG. 40. South side of the Segnes Pass, Glarus, Switzerland

the valleys down deep enough, they have laid bare the soft Cretaceous beds, which dip gently under the Paleozoic limestone or underlie it horizontally, exactly like any normal stratification plane. A more positive rebuke to the theory of geological succession could not well be imagined, for these Paleozoic rocks are supposed to be the very "oldest" fossiliferous rocks on earth, while the Cretaceous are pretty nearly the "youngest"; yet were it not for the exigencies of the theory, this whole region would be considered as only an ordinary example, on rather a large scale, of nearly horizontal stratification cut up by erosion into mountains of circumdenudation, with only occasional instances of minor disturbances here and there, such as are always to be found in an area of this extent. *Every scrap of physical evidence tends to show that these rocks were actually deposited in the order in which we find them.*

West of the Fairholme Mountain before mentioned, in the latitude of the Bow River and the Canadian Pacific main line, lies a narrow valley of Cretaceous beds, sixty-five miles long, called the Cascade Trough.[18] In this latitude, or just north of the 51st parallel, the total width of this wonderful area is about twenty-five miles, and there is only one Cretaceous valley running north and south. Some thirty miles farther south, there are two parallel Cretaceous valleys, and in some places three; while just south of the 50th parallel, at Gould's Dome, *there are five parallel ranges of these*

[18] Fig. 38.

Paleozoic mountains, with four Cretaceous valleys intervening, one of them, the Crow's Nest Trough, being ninety-five miles long, as stated by Dawson.

It would not be profitable to enter into further details, but we ought now to get a broad view of the total area involved. The Hon. R. W. Brock, director of the Canadian Geological Survey, informs the writer that "all the Rocky Mountain tract up to the Yellowhead Pass may safely be included" in this great faulted area, adding, "North of the Yellowhead it no doubt extends, but we have not sufficiently detailed information to set boundaries." Its southern limits are almost equally indefinite, Dr. George Otis Smith, director of the United States Survey, informing the writer that this great "fault," as it is termed, has been traced "southward to the crossing of the Great Northern Railway, and it is probable that it extends still farther to the south, as a fault of similar character has been noted at the head of Sun River, west of Great Falls," near the central part of Montana. Thus this region, which is rapidly becoming famous in geological circles as the "great faulted area," or the "Lewis overthrust," must be about *five hundred miles long,* north and south, with an average width of perhaps thirty miles at least from east to west, making a total area of some *fifteen thousand square miles.* Further investigation is more likely to increase this area than to diminish it, though possibly our more detailed knowledge may find occasional interruptions to the marvelously uniform character of these Paleozoic rocks on top of the Cretaceous,

especially since there is in some places a regular *alternation* of Paleozoic and Cretaceous, as has occurred in the Alps and elsewhere.[19] Besides, complications and misinterpretations may be expected to arise from the fact that the resemblance between the Cretaceous shales and the Banff series of the Paleozoic, usually classed as "Permo-Carboniferous," is "so close that it becomes impossible in many places to separate them without fossil evidence," as R. G. McConnell naïvely remarks of the portion of this region which he describes; for throughout the central portion of this area, as this author declares, "notwithstanding the complete absence of all the intervening formations, no unconformity was anywhere detected between them, except where faulting is known to have occurred"—that is, where they are found in the upside-down order. "The apparent conformity is perfect, even in the clearest sections, and the difficulty in drawing an exact line between the two series is further increased by the close lithological resemblance" between them.[20]

It has recently developed that rich Cretaceous coal beds and oil shales occur all up and down the Flathead Valley, to the west of the Glacier National Park, and that these beds likewise run under the Algonkian mountains of the park in a nearly horizontal position, just as the Cretaceous strata of the plains run under from the east. Thus the entire Glacier National Park is ringed around with Cretaceous beds,

[19] See page 113, also pages 109-112 of this volume.
[20] "Annual Report," 1886, Part D, p. 17.

which run under it in just as natural a way as the soil runs under a building. In fact, the whole Park may be properly regarded as a gigantic outlier, resting in a perfectly natural way upon Cretaceous beds,—resembling a huge Algonkian island, or perhaps peninsula, floating on a Cretaceous sea.

VI

There is nothing obscure or technical about this example. It does not even require any training in technical geology to appreciate this evidence. All it requires is a little common sense and a willingness to abide by the well-known scientific principle of believing obvious facts in the face of any theory whatever, no matter how venerable the theory may be.

The very obvious naturalness of these Paleozoic rocks resting upon the Cretaceous, as well as the immense area involved, makes this example a crucial one in disproof of this whole theory of life-succession. Why should such facts be blinked or tortured to save such a theory? I have nothing at all to say against real faults or real folds in the strata, when they can actually be seen and proved objectively. Every one who has traveled with his eyes open in any mountain region on earth, even though he be not a geologist, knows that there are such things as faults and such things as folds, though they are usually to be measured in feet and yards, instead of in miles and degrees of latitude and longitude. But when the upper strata have every objective appearance of being now in their normal position, so much

so that they may even appear to be *conformable* to the beds below them over miles of area, and the only suggestion of a thrust fault or an overthrust fold is that the fossils are here in the wrong order, every law of inductive reasoning commands us to take the objective fact instead of the *a priori* theory.

In the calm safety of our libraries, we may talk composedly of an immense mountain region's having

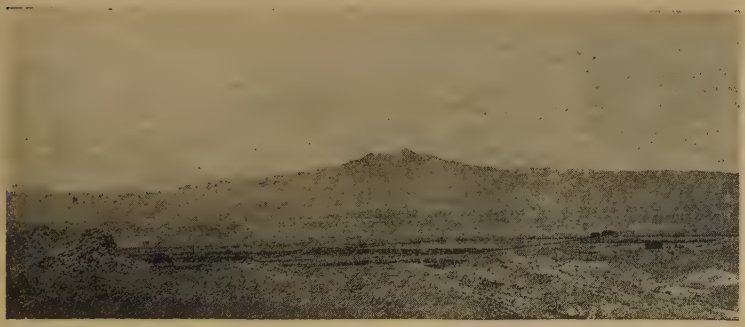


Fig. 41. Hart Mountain, from three miles east of Cody, Wyoming. The cap of this mountain is composed of Madison limestone (L. Cretaceous), and rests in apparent conformity on Eocene beds. This cap is manifestly an erosion remnant which was once continuous with the cap of Chalk Mountain, some fifteen miles to the southwest. Doubtless a sheet of these strata once extended over all this region. The theory of a gigantic "thrust" is merely an attempt to save the old theory of the "invariable" order of the fossils. (Hewitt, U. S. G. S.)

been "turned upside down over an area of 450 square miles," as Dana does, or of several thousand square miles of mountains traveling bodily forward for twenty or thirty miles; but those who speak thus are surely using words without any mental equivalent. In short, it is time to speak out what every reader has already said in his innermost soul,—that such great earth movements would be incredible in the face of any amount of evidence; but when *the physical*

evidence is all against them, and nothing demands such incredible dislocations except an otherwise highly questionable *theory,* common sense tells us to throw away such a theory and adopt the most obvious explanation of the facts; namely, that *these rocks were really laid down in the order in which we find them.*

And why may we not be allowed to say that these rocks are in a normal order, and that the Cretaceous were, throughout this whole area, generally deposited before the Paleozoic? Is modern science to be eternally obliged to say that "Strata" Smith and Cuvier and Werner were gifted with a supernatural knowledge of how the rocks must always be found to occur in other parts of the world? And whenever they are found in the contrary order, must we believe any incredible fiction in plain contradiction to our eyesight and common sense rather than impugn the memory of such supernatural wisdom? *How much of the earth's crust would we have to find in this antievolution sequence in order to discredit this life-succession theory?* What conditions of the strata could be found to convince modern scientists that we have for all these years been following a fantastic theory and an unscientific method? Language fails me; for I do not know what would convince the world if this evidence here in Alberta and Montana is insufficient.

VII

"The Bannock Overthrust," as described by Richards and Mansfield, "extends approximately 270 miles from the vicinity of Woodruff, Utah, to the north of

John Grays Lake," Idaho. Several other similar examples of "thrusts" lie parallel to this to the east, in the state of Wyoming, and both upper and lower beds are variously classified at present; but it is always "older" rocks lying upon much "younger" ones. From the descriptions, with maps and photographs accompanying them, it seems clear that we have here also simply a case of beds in a perfectly

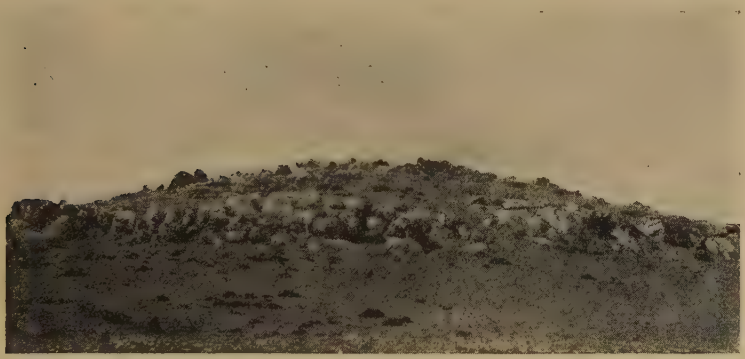


Fig. 42. Erosion remnant of Bighorn limestone (Ordovician) overlying Tertiary beds, East Peak, McCulloch Peaks, Bighorn Basin, Wyoming. (Hewitt, U. S. G. S.) This is a part of the so-called "Hart Mountain overthrust," where Carboniferous limestones comprise the tops of several peaks, with much younger (Eocene) strata underneath.

normal position outcropping in a complicated way through several valleys over a large area, the ordinary stratification plane between the upper and the lower beds being called a "thrust plane," solely because the beds are in the wrong order. The authors attempt to correlate all these areas with others to the north, not only with the immense one described from Alberta and Montana but also with the one to the east of the Bitterroot Mountains, and with the

one in the vicinity of Philipsburg, Montana. All these, they say appear to be in "the same zone" of upside-down conditions, and all "may eventually prove features of the same tectonic event."[21]

In the southern Appalachian Mountains of eastern Tennessee and northern Georgia, is found another famous "thrust," which exhibits a structure "almost identical"[22] with the one in Montana and Alberta. Here we find Carboniferous strata dipping gently to the southeast, like an ordinary monocline, *under* Cambrian or Lower Silurian, one of these so-called faults having a reported length of 375 miles,[23] while in another instance, the upper strata are said to have been pushed something like eleven miles in the direction of the thrust.[24] These conditions, we are told, "have provoked the wonder of the most experienced geologists,"[25] because of the perfectly natural appearance of the surfaces of the strata thus affected; or, as Willis puts it, "The mechanical effort is great beyond comprehension, but the effect upon the rocks is inappreciable," and "the fault dip is *often parallel to the bedding* of one or the other series of strata";[26] or, in other words, the so-called thrust plane looks exactly like an ordinary stratification plane between conformable strata.

[21] *Journal of Geology*, November-December, 1912.
[22] McConnell.
[23] Bailey Willis, in Geological Survey, Annual Report, Vol. 13, p. 228.
[24] C. W. Hayes, in Bulletin Geological Society of America, Vol. 2, pp. 141-154.
[25] Willis, *op. cit.*, p. 228.
[26] Id., p. 227.

Without entering into further details here, we must pass over to the Highlands of Scotland, where, as Dana says, "a mass of the oldest crystalline rocks, many miles in length from north to south, was thrust at least ten miles westward over younger rocks, part of the latter fossiliferous"; and he further declares that *"the thrust planes look like planes of bedding, and were long so considered."*[27]

Geikie quite naturally devotes several pages in his "Textbook" to a description of these conditions in the Highlands; but from one of his first reports on these observations, published in *Nature,*[28] we get some much more suggestive details.

The thrust planes, he says, are difficult to be "distinguished from ordinary stratification planes, like which they have been plicated, faulted, and denuded. Here and there, as a result of denudation, a portion of one of them appears capping a hilltop. One almost refuses to believe that the little outlier on the summit does not lie normally on the rocks below it, but on a nearly horizontal fault by which it has been moved into its place."

Speaking of some similar conditions in Ross Shire, which, before the fossil evidence had been worked out, had been described as naturally conformable, he declares:

"Had these sections been planned for the purpose of deception, they could not have been more skillfully devised, . . . and no one coming first to this ground would suspect that what appears to be a normal stratigraphical sequence is not really so."

[27] "Manual," pp. 111, 534.
[28] Nov. 13, 1884, pp. 29-35.

FIG. 43. Map of Glarus and Vicinity, Switzerland

"When a geologist finds" things in this condition, he says, "he may be excused if he begins to wonder whether he himself is not really standing on his head."

VIII

But it would be unprofitable to pursue this subject further, no matter how entertaining it might be in illustrating the ludicrous, childlike faith in this theory exhibited by illustrious men who are otherwise clear reasoners. Those who wish to do so may find additional examples of the strata in these antievolution conditions throughout the larger works of Dana, Le Conte, Prestwich, Geikie, and Suess, to say nothing of the more detailed statements given in the numerous government reports of all the English-speaking countries, and ponderous monographs in German and French by such men as Heim, Schardt, Lugeon, Rothpletz, etc. The last named, for example, describes how, in the district about Glarus, an enormous mass of mountains must have "traveled from east to west a distance of twenty-five miles from the Rhine Valley to the Linth," while in the east of Switzerland, the "Rhætikon Mountain mass traveled from the Montafon Valley to the Rhine Valley, about nineteen miles from east to west."[29]

The following summary of the situation in the Alps is given by Prof. Albert Heim, in an address at Zurich in 1907:

"As in Glarus [Figs. 43 and 44] the valleys are cut down into the young Tertiary rocks, while the mountain peaks are

[29] *Nature*, Jan. 24, 1901, p. 294.

FIG. 44. Linth, Canton of Glarus, Switzerland

crowned with the old Permo-Carboniferous (Sernifit), so also, for example, the Nikolai Valley is cut down through the Jurassic and the Triassic, and the old crystalline schists form in the Matterhorn [Fig. 45], Dent Blanche, and Weisshorn the overlying cover of a northerly directed overthrust fold. And in the very same manner the valleys of Schams and Rheinwald cut into Triassic schists, while the cliff-like tops round about are crowned with faulted caps of other older rocks of southern origin (for example, the limestone mountains of Splügen). *Thus we see that very many mountains of our Alps are composed, in their upper formations, of faulted older rocks which lie on top of younger ones* without any direct connection with the bottom. . . . These flat-lying faults, of which the Glarus folds were the first to be discovered, are a universal phenomenon in the Northern and the Central Alps, and their origins lie in the central and the southern regions."[30]

More recently, however, geologists have enlarged their ideas about the extent of these huge earth movements in the Alps, and they now speak of their having resulted in "pushing the Southern or Lepontine Alps about sixty miles to the northward into the Helvetic region. Erosion has since carved up these overthrust sheets, leaving remnants lying on foundations which belong to a more northern portion of the ancient sea. Most noted of these residuals of overthrust masses is the Matterhorn, a mighty mountain without roots, a stranger in a foreign geologic environment."[31]

IX

A paper in the *Journal of Geology*[32] by R. T. Chamberlin and W. Z. Miller, is entitled "Low-angle Faulting"; and endeavors to deal with all these

[30] "Der Bau der Schweizeralpen," p. 17.
[31] "Textbook," Schuchert, p. 924.
[32] January-February, 1918.

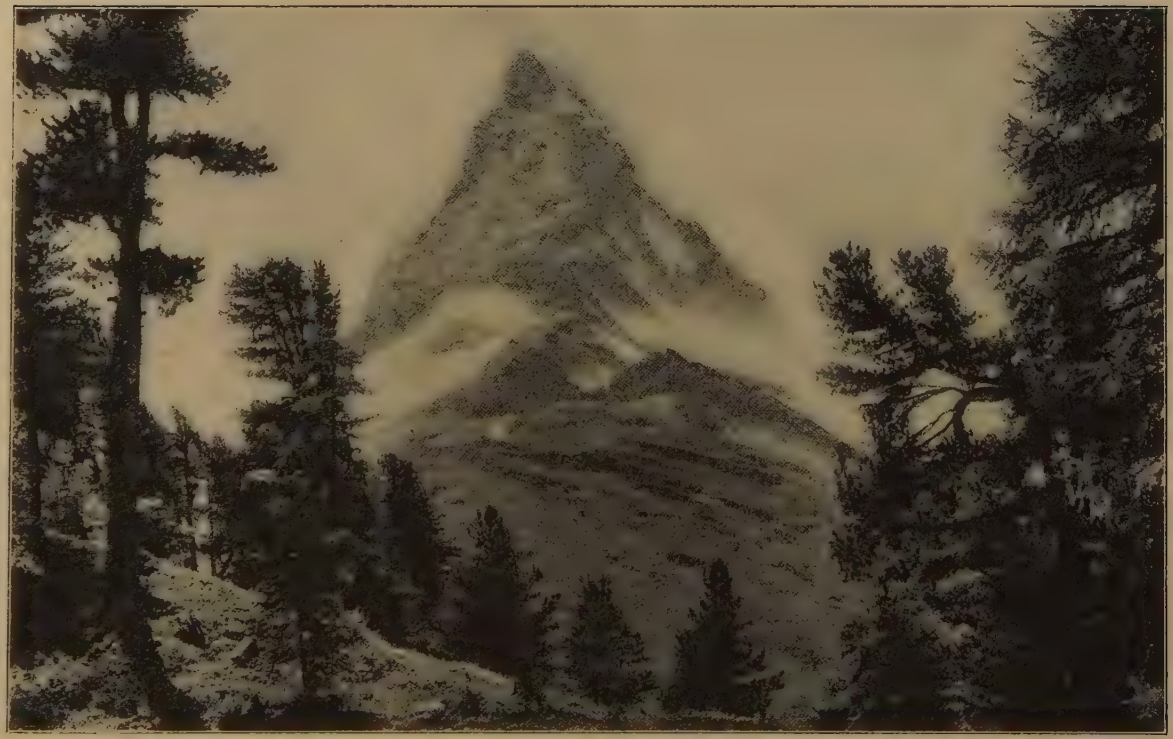


FIG. 45. The Matterhorn, Canton of Valais, Switzerland

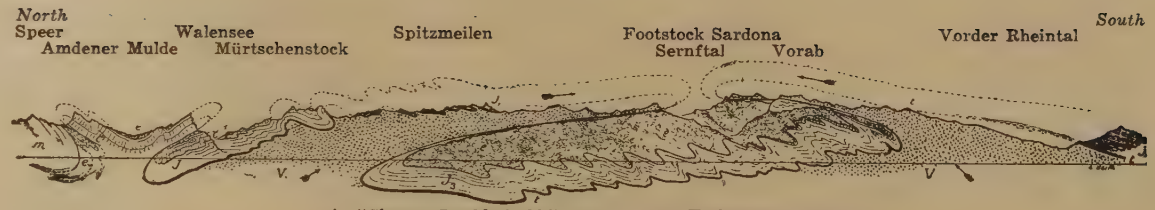
various phenomena as a class. These authors give several examples, which I have not the space to list here. They emphasize the fact that normal faults are almost always at a high angle; while all these so-called thrust faults approach the horizontal. "The distinguishing features of the overthrusts are the extremely low angle, which often approaches horizontality, and the very great displacement along the plane of slippage."[33]

After giving a considerable list of these overthrusts, and speaking of others from Spain, Eubœa, the Balkans, and the island of Timor, these authors proceed:

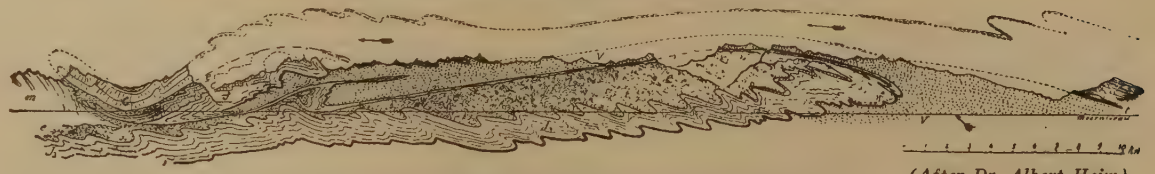
"Detailed studies elsewhere,— practically the world over, indeed,— are bringing to light overthrust faults of great displacement along gently inclined planes. This sort of faulting seems, therefore, to constitute *a phenomenon of a definite, independent type.* It seems to belong to *a genus of its own,* distinct from the ordinary reverse fault, though the two are no doubt[?] connected by composite types that bind them together. The common reverse fault is defined by displacement along planes neighboring 45° or a little less, and is confined to more limited movement on these planes, while the great overthrusts slide along planes that approach horizontality and involve displacements of astonishing magnitude."[34]

In the opinion of the present writer, *some* of the reverse faults here spoken of, as well as *all* the "overthrusts," in distinction from ordinary or normal faults, are pure theoretical inventions, called into existence by the necessity involved in finding strata in a relative order different from that taught by the theory of the geological succession.

[33] Id., p. 43.
[34] Id., p. 7.



A. "Glarner Double Fold," 1870 to 1902, Escher and Heim



(After Dr. Albert Heim)

B. "Glarner Thrust-fault," 1883 Bertrand, 1892 Suess, 1903 Heim

m — Molasse (Middle Tertiary)	*C* — Cretaceous	*t* — Triassic (Röthidolomit)
e — Flysch (Lower Tertiary)	*J* — Jurassic	*V* — Verrucano (Permian)

FIG. 46. ANTI-EVOLUTIONARY CONDITIONS OF THE ROCKS IN GLARUS AS VARIOUSLY EXPLAINED

It is thought by some who are unacquainted with geological methods that there must be real physical evidence on which these theories of thrust faults and overthrust folds are based. But in this sketch of the rocks as found in Glarus, the most famous of these anti-evolutionary conditions, because the best and longest known, we see that what was formerly called a "double fold," with the Jurassic and Triassic rocks folded in from both sides toward the Sernf Valley, is now called a "thrust fault," with the rocks all pushed one way. And of course it should always be remembered that all the lines in the above diagrams except those in the upper part of the pictures and the actual outcrops *are purely imaginary.* They are merely ideal sketches of what this author thinks must be the conditions underground according to his theory. But the very fact that what was long regarded as two completely overturned folds is now regarded as one flat-lying thrust-fault, is proof positive that there is no physical evidence of a real overturning of the strata. The fossils are here in the wrong order; that is all. And to save the life-succession theory, this diagram is given as an attempted explanation. As Dr. Albert Heim once expressed it in a letter to the author, that the strata over immense areas are thus in a position contradicting the current theories, "is a fact which can be clearly seen—*only we know not yet how to explain it in a mechanical way.*"

The Carnegie Research Expedition in Asia recently reported one of these great "displacements" across northern China for the distance of five hundred miles, but say that "to what extent these structures are general in North China is not yet determinable."[35]

The Salt Range of India is now reported to consist of Cambrian beds on top of Tertiary.

But enough! What we really need is not more facts along this line, but a more candid, a more truly scientific attitude of mind in considering the facts we already have. For in no other branch of natural science is there such a theory still surviving from the past age of subjective speculation, which is still treated as a Procrustean bed to which all subsequently discovered facts must be compelled at any cost to conform — not another one for which otherwise competent observers will thus freely sacrifice their common sense. When the dividing line between two sets of strata "acts exactly like the line of contact between two nearly horizontal formations," so much so that in a natural section cut out by a river the two "appear to succeed one another conformably," surely a calm, judicial mind, divested of all theoretical prejudice, instead of talking about these conditions having been planned by nature "for the purpose of deception," will find no difficulty at all in believing that these rocks were really laid down in the order in which we now find them, the "younger" first and the "older" afterwards; and only one under the hypnotic spell of a preconceived theory would indignantly deny

[35] "Research in China," Vol. 2, p. 90.

the possibility of these strata having been laid down as we find them. There is no trace of the candid scientific spirit in this denial of all the physical evidence, and in the invention of incredible "thrusts" to neutralize this evidence and maintain the evolutionary order of the fossils.

CHAPTER VI

Natural Chronometers: Fact Number Four

I

After what has been proved in the previous pages, especially in the last preceding chapter, the author feels that he almost owes an apology to the intelligent reader for pursuing this line of argument any further. It is too much like mutilating an enemy after he is already dead. For in the light of the facts already brought forward, the scheme of exact chronological ages, based on the succeeding types of life, is seen to be not only unproved; it is impossible and absurd. Yet since it has been planned in the present work to give a complete review of the whole question in such a way that the subject need never be reopened, we must consider briefly another series of facts, each of which, if taken singly, may not be at all equal to some of the facts already presented, but which, taken collectively, go a long way toward confirming the worthlessness of the fossils as in any way tests of relative age.

In our modern world we have some *six* sets of agents which are now at work, or have been at work, on the rocks of the globe; and these agents are all of such a character that the records of their work may serve in a rough way as time-checks, in considering how or when the various stratigraphical deposits were

made. And my Fact Number Four, which will complete the stratigraphical phase of my argument against the chronological distinctions made between the various geological deposits, is that *all these time-checks seem to make no such distinctions between the various formations, but seem to treat them all as of essentially the same age, and as if they had begun their records only after all the fossiliferous strata were laid down.*

These various agents which may be used as rough time-checks, are certain rivers, the major breaks or faults, the strand lines around the continents, the fossils lying still uncovered on the ocean bottom, the making of the mountains, and the evenness of the sky line of most mountains. This list covers about all the agents which have been in business since the dry land appeared and which have left us a readable record of the work they have been doing since in the way of geological changes; though in the case of the mountains (and perhaps also in the case of the raised beaches), it is rather a record of what took place coincident with, or immediately subsequent to, the appearance of the dry land.

But this is surely a notable fact (if we find it to be a fact) that all these agents agree in disregarding completely the alleged great distinctions in age between the various fossiliferous formations, and that on the contrary they seem to treat all these formations as of the same age and as if they began their work upon all of them at about the same time.

II

Let us *first* consider the case of the rivers.

To be sure, it is evidently in only a few cases where the records are so free from ambiguity as to be quite incapable of being misunderstood; that is, the cases of rivers with steep rocky gorges, or those that cut through mountain ranges. But there are several such rivers in the world, and they all seem to tell the same story.

The famous Colorado River is a good example. (Fig. 47.) It flows from "younger" strata into "older" in its deep cutting across the Arizona plateau.[1] That is, the rocks in the lower part of this river are "older" than those farther up toward its source. Stated in terms of the current theory, this means that when the region of country about the lower part of this river's course first became dry land, the upper part was still sea, and that thus there was no such river in existence here until the very "youngest" of these rocks was formed. For otherwise the river must have started running from the sea toward the dry land, that is, running uphill. Stated in terms neutral as to theory, it means that the whole region of country drained by this large river, with its rocks of many varying "ages," was elevated practically as it is now, before this river began its work of erosion. It treats all these rocks as if they were of the same age, and as if it began sawing at them all at the same time.

[1] See "History of Geology," Zittel, pp. 210, 211.

FIG. 47. Cañon of the Colorado River

In the case of the Colorado, Zittel says that "Powell's explanation of the apparent enigma is that, after the river had eroded its channel, rocks were uplifted in one portion of its course, but so slow was the rate of uplift that the river was enabled to deepen its channel, either proportionately or more rapidly, so that it was never diverted from its former course."

It was by similarly cunning inventions that the early writers on astronomy, alchemy, and medicine evaded the force of accumulated facts which told against their absurd theories.

Such rivers are known in geology and physical geography as "antecedent" rivers, since the theory is that the rivers existed before the mountains or plateaus through which they cut their way, these mountains or plateaus having been elevated across their courses since the rivers got started. Of course, this is only a theory, the plain fact being that these rivers flow across country containing rocks of alleged different ages, and yet treat them all as if they had not begun work upon these land areas until the *very last* of these rocks were laid down; that is, they treat all the rocks as if they had been formed at one time, and as if they themselves began their work of erosion over all these rocks up and down their courses at one time.

The Columbia River is called an antecedent river with respect to the Cascade Mountains through which it flows. The Meuse River of France is called an antecedent with reference to the Ardennes highland, through which it makes its way by means of a deep,

narrow gorge.[2] The Rhine, where it crosses the highlands of central Germany, is spoken of as an antecedent stream.[3] Other examples occur in the case of the Danube, the Sutlej of India, and elsewhere.

III

There are other great geological factors which may also serve somewhat as time-checks, though they are not so much like real chronometers as are the rivers of the world. We must briefly consider the others.

The *next* to be here considered are the great breaks, or the major faults, in the strata. "They affect the whole mass of the rocks in almost every instance where they occur, instead of being limited by the boundaries of particular formations."[4] There are many minor faults which are thus limited. The so-called "ninety-fathom dyke," of the north of England, runs across the country for 110 miles or more, and "pays no respect to formations." The same may be said of the great "whinstone dyke" of Yorkshire and Durham, England, which is some 65 miles long. Many much larger faults are known elsewhere, such as the San Andreas Rift of California, which is supposed to be more than 500 miles long.

The *third* class of agents which we may use as time-checks are the old strand lines which surround all the continents. They are the same on the Archæan, Carboniferous, Cretaceous, or Tertiary coasts indifferently. To quote some words from Professor

[2] "Textbook," Grabau, Vol. 1, p. 743.
[3] "College Physiography," Tarr, p. 191.
[4] George Young.

Suess: "All the relics of the ancient shore lines of which we have made mention are always horizontal, and absolutely independent of the structure of the coasts, . . . and extend around all coasts and under every latitude in complete independence of the structure of the continents."[5]

FIG 48. Map showing the position and extent of the fault-line, A—A, movement along which produced the earthquake of April 18, 1906.

A similar testimony is given by T. C. Chamberlin:

"As a matter of fact, all the continents are strikingly alike in their general physiographic attitude toward the sea. They are all surrounded by a border-belt, overflowed by the sea to a nearly uniform depth of one hundred fathoms."[6]

[5] "The Face of the Earth," Vol. 2, p. 550.
[6] "Outlines of Geologic History," p. 301.

FIG. 49. View of the Sierra Nevada Range, Inyo County, California, from the eastern side of Owens Valley. Note the horizontality of the sky line. (Walcott, U. S. G. S.)

This reference is to the present strand line; but it is in accord with the record of the older ones.

A *fourth* class of facts is regarding the ancient fossils which are now found lying exposed on the deep ocean floor, with no covering over them of more recent deposits. Geologists have been astonished at finding so many extremely "ancient" fossils in this situation, and have interpreted this fact as proving how very, very slowly the oozes must accumulate on the ocean bottom. Just as logical and probable a conclusion would be that these facts show the comparative *recency,* or youngness, of these fossils. But the one point with which we are concerned here is that these fossils are *just about as likely to be Mesozoic or Paleozoic as Tertiary.* That is, the fossils found in this condition, not yet covered over by subsequent deposits, belong, many of them, to some of the "oldest" formations; and yet they do not seem to have been any more completely buried by the accumulations of the subsequent millions of years (according to the evolutionary theory) than some of the Tertiary or Pleistocene fossils which are found in the same situation.

Our *fifth* series of facts in this connection is regarding the making of the mountains.

Necessarily, any given mountain range could not have been elevated until after the very *latest* strata composing it had been laid down by the waters as sediments. And the interesting thing in this connection is that by this principle about all the mountains have to be called very "young," as practically all of

them contain Tertiary or even Pleistocene strata. Dana declares that this fact "is one of the most marvelous in geological history." And he goes on to say, "It has been thought incredible that the orographic climax should have come so near the end of geological time, instead of in an early age when the crust had a plastic layer beneath, and was free to move; yet the fact is beyond question."[7]

Essentially all the great mountain chains of the world could be listed here as illustrative examples. It would be tiresome to quote them specifically. It may suffice to repeat what Bailey Willis says regarding the great mountain chains of Asia; namely, that they "challenge credulity by the evidence of their extreme youth."[8] For he has to assign the uplifting of these huge mountain ranges "chiefly within the Quaternary,"[9] or the Pleistocene.

The uniformity or simultaneousness of the uplift of the great mountain ranges would constitute a *sixth* series of facts along the line of these others.

In the *Journal of Geology,* January-February, 1923, is a long article by Prof. W. M. Davis, entitled "Erosion and the Summit Levels of the Alps," being a review of a paper by Prof. Albrecht Penck, "*Die Gipfelflur der Alpen*" (1919). In this article Davis says:

"If one stands on a main summit, countless other summits rise like waves of the sea with crests of similar height, in spite of the very dissimilar heights that the summits should hold if

[7] "Manual," p. 1020.
[8] "Research in China," Vol. 2, p. 24.
[9] Id., p. 99.

they still represented the unequal deformational uplifts that the different parts of the range have undergone."[10]

Penck holds that these coördinate summits represent an "upper limit of denudation." But it would be just as legitimate to argue that they prove that all the range was uplifted at once, and that "the unequal deformational uplifts" spoken of by Davis did not occur; for it looks as if the uplifting occurred only after all the strata were formed, erosion having since dissected the mass up into the diversity which we now see. Davis says that this coördination of the Alpine summits is "a striking feature" of the Alps. It is also a very striking feature of the Sierras of California, and indeed of all the other great mountain ranges, so far as I am aware.

Thus the coördination of the summits of each of the great mountain ranges constitutes the *sixth* series of phenomena here considered, all of which seem to indicate that the great forces of nature absolutely ignore the alleged distinctions in age attributed to the various parts of the strata of a country or a continent.

Thus we have listed a *sixfold* series of important geological records: the rivers, the major faults, the strand lines, the fossils lying exposed or not yet covered up on the ocean floor, the astonishing "youngness" of the great mountain ranges, and the evenness of their summits or their even sky line. All these phenomena agree in this one general principle; namely, that *they appear to treat the fossiliferous*

[10] *Journal of Geology*, January-February, 1923, p. 2.

strata as if they were all of about the same age, or what amounts to the same thing, as if they had started their work upon them only after all these strata had been laid down. Thus our *Fact Number Four* is that all these varied time-checks seem to treat the formation of the sedimentary strata *as substantially one event;* though they do not furnish us with even an approximate date for this event. On this latter point, the many blunders of the past ought to teach us caution. No system yet devised for reading absolute time from geological records seems to have any scientific value. But so far as these six great classes of geological time-checks are concerned, they all agree in appearing to treat the formation of the stratified deposits as *essentially one event,* and certainly not older than the human race, and not older than thousands of living species of plants and animals. We can not say much more than this with scientific certainty.

IV

We have now completed our survey of the strictly stratigraphical phases of the question in hand, and have found four very remarkable principles about the fossiliferous rocks, which it may be well to summarize here before proceeding further:

1. Plenty of "young" formations, like the Cretaceous or the Tertiary, occur over wide areas resting directly on the Primary or Primitive; and such beds usually are highly consolidated or metamorphosed, thus in position and in texture resembling the very oldest deposits on the globe.

The converse of this fact is also true, for Cambrian and Ordovician beds are found which look just as young as any Tertiary or Pleistocene, consisting of muds "scarcely indurated" and of sands "still incoherent."

In both these classes of cases, the theories regarding the age of the rocks, as based on the fossils, contradict our eyesight and common sense.

2. Plenty of very young strata are found in perfect conformity on strata alleged to be many millions of years older. Often the two sets of strata are lithically alike, and can be separated only by their fossils; and every physical and common-sense evidence tells us that no great interval could have elapsed between the two formations. They appear to have followed one another in quick succession. The many millions of years which are alleged by the evolutionary theory to have occurred *in between* these two successive beds must be mythical.

3. In very many instances and over wide areas, the "standard" order of the strata is reversed, with every physical evidence tending to prove that the rocks were actually deposited in the anti-evolution order in which we find them. If they were deposited in the order in which we find them, the whole scheme of evolutionary geology must be a blunder.

This and the preceding generalization may be combined into the following comprehensive statement, which is, by all odds, the most important general fact or principle which has hitherto been discovered in connection with this subject of the relationship of the

strata. I have called it the *Law of Conformable Stratigraphical Sequence;* and it may be stated as follows:

Any kind of fossiliferous rock, "old" or "young," may occur conformably on any other kind of fossiliferous rock, "older" or "younger."

4. All the great geological phenomena which may be regarded as natural chronometers or time-checks, such as the rivers, the great faults, the strand lines, the fossils lying on the ocean bottom, the making of the mountains, and the simultaneousness of their uplifting,—all seem to treat the making of the fossiliferous strata as *essentially one event,* and completely ignore the alleged varying ages of the different fossiliferous formations.

Now I do not know what additional class of facts can be demanded or even imagined to complete the demonstration that there is no particular *order* in which the fossils can be said to occur; that is, any order which indicates a succession in time for the fossils. And since the only shadow of an objective argument ever put forward to defend the evolutionary, or life-succession, theory of the fossils has been that the fossils always occur in the same relative order of sequence, we find that this solitary argument is false *in toto.* It is a good deal like the problem proposed by Charles II to the bishops,—why a dead fish increases the weight of a glass of water in which it is contained, while a live fish does not. Considerable learned discussion was expended over the subject, until some one suggested the plan of trying it by

actual experiment and seeing if it were really so, with the result that the whole thing was found to be only another joke of the Merry Monarch. But the geological problem is very similar. For nearly a century, the learned world has said that there must have been a succession of life on the globe, *because* the rocks always occur in a certain relative order of sequence. But in the light of modern discovery, it turns out that they do not do anything of the kind. We really find them in every conceivable order of relationship to one another. Hence it is hard to see how this evolutionary doctrine of life-succession, so utterly destitute of defense as an abstract idea, and now found to be at variance with a thousand observed facts, will longer be able to hold up its head in the company of the true inductive sciences.

V

I appeal to my fellow workers in other lines of natural science — not so much to geologists, but to chemists, physicists, and astronomers, to workers in medicine, jurisprudence, and philosophy — whether we do not have here a sufficient amount of unequivocal evidence to call for a complete reconstruction of the common geological theory of an alleged historical *order* in which the fossils are to be found. Surely the thousands of persons who are familiar with scientific methods of reasoning as employed in all the other departments of knowledge can not much longer stand patiently by while such a travesty on Baconian methods usurps the place of sensible adherence to

proved facts in these fundamental questions of geology. They must soon rise up in their might and say that such a burlesque on inductive methods must cease forthwith.

Of course, in all this, I am dealing only with *relative* time. This line of argument is wholly independent of the question of how long it has been since any or all of the geological changes took place. The question of length of time *since* has nothing whatever to do with the logic of the case. This line of argument merely gets us forever rid of the life-succession theory as a possible hypothesis; and now, admonished by past mistakes, we must begin over again and reconstruct the theoretical part of the science of geology in the light of all that modern science has discovered.

It is true, some fossiliferous deposits, metamorphosed almost beyond recognition, and buried deep beneath thousands of feet of subsequent deposits, have enough appearance of remote antiquity about them in all conscience. But to increase this antiquity on fossil evidence only by saying that other equally prodigious masses of rocks elsewhere were deposited long *after* these, or by pointing to still other deposits in another region which are said to be *older* than any of the others, is a most illogical and unscientific procedure.

I thoroughly sympathize with the attitude of mind that stands dazed at the length of time occupied in any considerable geological event, when considered separately on the basis of the uniformitarian action

of the elements, and without that broad view of the fossil world as a whole which can frame a true induction from the sum of all our ascertained facts. But some other word than "sympathy" is needed to describe my feelings for the mind that can, in the face of the principles here brought out, continue to arrange the rocks off in exact chronological sequence over the whole earth, and treat these successive ages as if they had an objective validity.

And surely it is scarcely necessary, in this enlightened age, to point out how completely this vitiates any biological argument (such as that of organic evolution) which has incorporated into its system the results of such illogical reasoning, or which is in any way dependent upon the conclusions of such a theory of geology. In view of the laws of evidence, which every intelligent person is supposed to understand nowadays, surely some strange things passed for scientific proof during the nineteenth century. For, as we have seen, the earlier geologists did little better than assume the succession of life bodily; then Agassiz and his contemporaries arranged the details and the exact order of these successive life-forms by comparison with the embryonic life of the modern individual; and now the evolutionists of our day, led by such men as Fritz Müller, Spencer, and Haeckel, with their "biogenetic principle," prove their theory of evolution by showing that the embryonic life of the modern individual is only "a brief recapitulation, as it were, from memory," of the (assumed) geologi-

cal succession in time."[11] Surely this will some day make a more amazing record for posterity than those of phlogiston or the epicycles of Ptolemy.

VI

If it is now asked, What do the rocks have to tell us, in view of the fact that they refuse to testify to a life-succession? I can only say that we are not as yet in a position to decide this question. There are several other matters connected with the character and mode of occurrence of the fossils that are almost equally important with anything already considered in forming a true scientific induction regarding this matter. These facts must be considered in subsequent chapters. Already, however, we can say this much: that we have in the rocks almost as complete a world as the living world of to-day — in some re-

[11] This method of arranging in ascending series the geological types of life, and placing alongside these the classification series of living animals, and then correlating with these two purely artificial arrangements the embryonic development of the modern individual as a third parallel series, has always been regarded as the culminating argument for evolution. But if, in addition to the exposure of the geological series given in the previous pages, we consider (1) how Agassiz, in the early days of geology, soon after the historic discoveries of Von Baer regarding embryology, made use of the embryonic development of each particular group *to determine what ought to be the geological order of the fossils of this group* — a custom which has grown with the passing years until it dominates absolutely this whole field of study; and if, further, we consider (2) how the modern taxonomic classification is continually *rearranged to bring it into more apparent agreement with this embryonic measuring line*,— then we may begin to appreciate why such men as Carl Vogt, Oskar Hertwig, His, and numerous others, with only a part of the light which we now possess, have discarded this favorite argument of Haeckel regarding biogenesis, just as T. H. Morgan in our own country says that it is "*in principle false.*" Whatever may be the real lesson to be learned from the embryonic development, to bring it in as argument for evolution is most fantastic and circular reasoning, considering the way in which it has been used to build up the geological series.

spects vastly more complete. With the life-succession theory repudiated, we have still to deal with the fossils themselves which have been thus systematically classified; but this geological series becomes now only the taxonomic, or classification, series of an older state of our present world, buried somehow and at some time or times in the remote past — the how and the when of which we have not at this stage of the argument the means to determine.

But I think we are now prepared to enter the mazes of the biological argument, and to study the subject of extinct species, which by many is supposed to furnish a line of independent evidence in favor of the life-succession theory.

CHAPTER VII

Extinct Species

I

Let us now test the value of this assumed life-succession by another very simple question. In "Eocene times," so we are told, England was a land of palms, with a semitropical flora and fauna. In fact, at this time, cycads, gourds, proteads (like the Australian shrubs and trees), the fig, cinnamon, screw pine, and various species of acacias and palms, abounded in England and western Europe. Then again, in the Pleistocene deposits of the same countries, we find various species of elephant and rhinoceros, with a hippopotamus, a lion, and a hyena, identical with species now living in the tropics.

Now, how are we to prove that these various Pleistocene animals did not exist together in these countries at the same time as the Eocene trees and plants before mentioned?

Lions and monkeys, hippopotami and crocodiles, with elephants, hyenas, and rhinoceroses, now live beneath the palms, mimosas, acacias, and other tropical plants represented in the Eocene and Miocene beds. What is there to hinder us from believing that they all lived there together in that olden time? Surely it would be the very irony of scientific fate if forms now so closely connected in life should in

death be so divided. Or, to present it in another form, Why should we be asked to believe that these acacias, cinnamons, palms, etc., lived and died ages or millions of years before the lions, the elephants, the rhinoceroses, and the hippopotami came into existence to enjoy their shade; and then, after these unnumbered ages had dragged their slow length along and vanished into the dim past, and all these semi-tropical plants had shifted to the tropics or been turned into lignite, these lions, elephants, and hippopotami came into existence in these same localities, when no such plants existed anywhere in Europe?

Surely we ought to expect some pretty substantial evidence for such a violation of our universal modern experience. We generally boast that we have outgrown the crude ideas of the earlier years of the science, when they spoke of "ages" of limestone making or of sandstone making; but it seems that some of us have not yet attained to that broad view of the essential solidarity of nature in which the flora and fauna of our world are seen to be just as indissolubly connected with each other. The close mutual dependence of the many parts of the great web of organic life is far better understood in modern times than it used to be; and it is wholly beyond our scientific understanding to see how some of these great groups of life could possibly exist without the others. Nature could as easily be persuaded to produce for a whole age nothing in the way of rock but limestone or conglomerate, as to adjust her powers to such an unbalanced state of affairs as is spoken of above,

with the animals in one age and the complementary plants in another.

But in considering this question as to why the Eocene plants and the Pleistocene animals may not be supposed to have lived contemporaneously, we are brought face to face with the *second* supposed argument in favor of there having been a succession of life on the globe. The answer given is that all the animals of these "early" Tertiary beds are extinct species, also very many of the plants; while the hyena, lion, hippopotamus, etc., of the Pleistocene are identical with the living species, and even the mammoth is so closely like its nearest surviving relative, the Asiatic elephant (*E. indicus*), that these also might be classed as identical.[1]

As this point is regarded by many as so important, and as it has such a vital connection with the whole life-succession theory, we must go into the matter somewhat in detail, even at the risk of appearing rather technical.

II

If the Paleozoic and Mesozoic strata are often of enormous extent, spreading in vast sheets over wide regions, so that their stratigraphical order in any particular district is quite readily made out, it is in most cases altogether different with the Tertiary and Pleistocene deposits. Here stratigraphy is utterly useless as a means of correlation. For these deposits resemble one another so much in everything except their fossils, and occur so generally in detached and

[1] See page 183 of this volume.

fragmentary beds, holding no stratigraphical relation to one another, that Lyell devised the plausible plan of distinguishing them from one another and arranging them in the accustomed order of successive ages, by their relative percentages of living and extinct Mollusca. With only unimportant changes, Lyell's divisions are still followed in classifying the Tertiary and Post-Tertiary beds. Those with *all* the species extinct, or less than five per cent living, are classed as Eocene; those containing *few* extinct forms, or nearly all living species, are classed as Pleistocene or Post-Tertiary. The Miocene and Pliocene represent the intermediate grades, and all are supposed to be in true chronological order. It goes without saying that in actual practice it is often so extremely difficult to adjust these differences that beds are assigned to an "early" or a "late" division on general principles, by what the literary critics would call "tact" or "intuition," rather than by the strict percentage system; though for these large and important divisions of Tertiary and Post-Tertiary rocks, these were actually the first and only reasons assigned by Lyell and the early uniformitarians on which the subdivisions were distinguished and arranged in the customary order of a historical sequence.

In the words of Dr. David Page:

"As there is often no perceptible mineral distinction between many clays, sands, and gravels, it is only by their imbedded fossils that geologists can determine their Tertiary or Post-Tertiary character."[2]

[2] "Textbook," Introduction, p. 189.

Now to say that a set of beds,— ninety-five per cent of whose fossils belong to extinct species, and only five per cent are now living,— must be vastly older than another set where these percentages are reversed —that is, where the species are nearly all living— seems, at first thought, an eminently reasonable idea. We immediately begin to imagine the long ages it must have taken for these exceedingly numerous and apparently vigorous species to wear out and become extinct in the alleged ordinary way by the merciless struggle for existence with forms more fitted to survive.

III

But it is hardly necessary to point out that all this is based on the assumption of *uniformity* in its most extreme type, a doctrine which not only denies that these living forms are merely the *lucky survivors* of tremendous changes in which their contemporaries perished, but which, in essence, is taking for granted beforehand the very point which ought to be the chief aim of all geological inquiry; namely, How DID THE GEOLOGICAL CHANGES TAKE PLACE? It would not be a very scientific procedure for a coroner, called upon to hold a *post-mortem*, to content himself with interesting statistics about the percentage of people who die of old age, fever, and other causes, while there was clear and decisive evidence that the poor fellow under examination had been *shot*. In this case, as in geology, it is not merely the result that is wrong, but the whole method of investigation. For, as in the latter case we don't want to know how people gener-

ally die, but how this particular person actually did die; so, in our study of geology, we do not wish to know merely the rate at which changes of surface and extinction of species are now going on, and then project this measure backward into the past as an infallible guide; but we wish to know for sure just what changes of this nature have taken place. A true induction is, I think, capable of deciding very positively whether or not the tools of nature have always worked at the same rate and with the same force as at present; and this method of arranging the fossils in supposed chronological order on the percentage basis as mentioned, is only an extreme form of methods claiming to be inductive which, in this age of the world, ought to be condemned as a shame and a disgrace, because, as Howorth says, they are based, "not upon induction, but upon hypotheses," and have "all the infirmity of the science of the Middle Ages."

Then again, it occurs to us that this method — of attaching a time-value to percentages of extinct or living species — would make the subfossil remains of the bison on the Western prairies almost infinitely *older* than those of the lion, hippopotamus, etc., in the Pleistocene beds of Europe; for (except for some few specimens artificially preserved, and which may be neglected in this connection) the bison is to-day practically extinct, while the Pleistocene mammals are found by the thousand in the proper localities, and show no signs of surrender in the struggle for existence. Similar comparisons might be made between the great wingless birds of Madagascar,

Mauritius, and New Zealand, and the many cases of "persistent" forms of invertebrates which have survived unchanged from Carboniferous, Silurian, or Cambrian times, a period of time which, in the language of the current geology, means a large fraction of eternity. But all these considerations show that the mere fact of certain species' being extinct and others' being now alive, is no trustworthy guide in determining the relative age of their remains, until we *first find out how they happened to become extinct.*

The inquiry as to the how and the when (relatively) is an absolutely essential preliminary in any such investigation, and is inseparably united in nature with the general question of how the great geological changes have taken place in the past. Of course, if everything like a world catastrophe is *a priori* denied; if, in other words, it is settled from the first that all these fossils, living and extinct, *did not live contemporaneously* with one another, the living ones being simply the lucky survivors of stupendous changes in which the others perished,—then all pretense of a scientific investigation of the subject is at an end. If a coroner has it settled beforehand that an accident or a murder could not possibly have occurred, then his profession of a candid *post-mortem* examination is only a farce; for he does not hold it to find out anything, since he knows everything essential about it beforehand. Uniformitarians would certainly make poor coroners, or for that matter, poor investigators of law or history, or of anything else.

Will some one please give us a reasonable explanation of why the lion, the hippopotamus, the rhinoceros, and the elephant shifted from England to the tropics? Will he tell us why the mastodons and elephants, the camels and the rhinoceroses, the megatheriums, and even the huge fossil horse, all disappeared from America *together,* so far as we can tell? Or will he explain how, at this same general time, some elephants and rhinoceroses were caught in the merciless frosts of northern Siberia so suddenly that their flesh has remained untainted all these centuries, and is now, wherever exposed, greedily devoured by the dogs and the wolves?

An abundant warm-climate vegetation once mantled all the polar regions, and its fossils have been found just about as far north as explorers have ever gone; while Dana says that "the incasing in ice of huge elephants, and the perfect preservation of the flesh, shows that the cold finally became *suddenly*[3] extreme, as of a single winter's night, and knew no relenting afterwards."[4]

Now, if no one can deny this *sudden* change of climate over half the world or so at least, is it not extremely unscientific to deny that this same cause, *whatever it may have been,* was quite competent to bring about a good many other changes, and the extinction of numerous other species, which, we are so often reminded, must imply the lapse of untold ages of time? The economizing of energy, or the

[3] Professor Dana has italicized the word "suddenly."
[4] "Manual," p. 1007.

famous law of parsimony known as "Occam's razor," is quite appropriate in this case, and may be referred to again in the sequel. The principle upon which I must here insist is that the mere fact of certain species' being extinct, and others' being now alive, *gives no clue whatever to the relative age of these remains, until we first ascertain why, how, and when this extinction was brought about.* Yet, though every one admits that tremendous changes of climate, etc., intervened between that ancient world and our own (the true extent and character of which, as I have said, ought to be the chief point of all geological investigation), no allowance seems ever to be made for this as a powerful cause of extermination of all forms of life. *On what grounds can our science discriminate among these extinct species, and fix on only a limited few of them that were made extinct by this event, and then arrange the others on the percentage system, as if such a catastrophe had never happened?* Or what possible scientific value can we longer extend to the distinctions based on such methods?

In the utter absence of any such explanation as to *how* and *when,* and assuming, in the very teeth of these facts, a dead-level uniformitarianism, the presence of ten, fifty, or a hundred per cent of extinct forms in a set of beds is manifestly of no scientific value in determining age. It would be many degrees more reasonable and accurate to arrange all the Greek and Latin books of the world in chronological order according to the percentage of their words which have survived in the English language. In-

deed, it would be much like a coroner at the inquest following a railway disaster, attempting to arrange the exact order in which the various victims had perished by the proportionate number of surviving relatives each had left behind him.

Such methods in any other line of research would soon make their advocates the laughingstock of the world. The reason why they do not meet this result in the case of geology is that these methods have been in vogue so long, and are sanctioned by the prestige of such illustrious historic names, that they exercise a browbeating, hypnotic spell over all the younger students of the science.

IV

And the completely worthless character of such "evidence" of age becomes, if possible, more apparent when we consider that very many of these so-called "extinct" forms are not really distinct species from their living representatives of to-day. "It is notorious," says Darwin, "on what excessively slight differences many paleontologists have founded their species." Even to-day, in spite of all that we have learned about variation, little or no allowance seems ever to be made for the effects of a greatly changed environment. (Fig. 50.) If the fossil forms among the mollusks and other shellfish, for instance, are not precisely like the modern ones in every respect, they are always classed as separate species, the older forms thus being "extinct," in utter disregard of the striking anatomical differences between

FIG. 50. Nineteen specimens of *Purpura lapillus* L., Great Britain, illustrating variation. 1, Felixstowe, sheltered coast; 2, 3, Newquay, on veined and colored rock; 4, Herm, rather exposed; 5, Solent, very sheltered; 6, Land's End, exposed rocks, small food supply; 7, Scilly, exposed rocks, fair food supply; 8, St. Leonard's, flat mussel beds at extreme low water; 9, Robin Hood's Bay, sheltered under bowlders, good food supply; 10, Rhoscollyn, on oyster bed, four to seven fathoms (Macandrew); 11, Guernsey, rather exposed rocks; 12, Estuary of Conway, very sheltered, abundant food supply; 13, 14, Robin Hood's Bay, very exposed rocks, poor food supply; 14, slightly monstrous; 15, 16, 17, Morthoe, rather exposed rocks, but abundant food supply; 18, St. Bride's Bay; 19, L. Swilly, sheltered, but small food supply. If these were all found only as fossils, how many species and genera would they make? (After Cooke, in "Cambridge Natural History.")

the huge Pleistocene mammals and their dwarfish descendants of to-day, which for a hundred years or so were declared positively to be distinct from one another, but are now acknowledged to be identical.

Of course, no one denies that there are numerous extinct forms among the invertebrates, just as we know there are among the huge vertebrates of the Mesozoic and Tertiaries, none of which we moderns have ever seen alive. Other forms do not appear familiar to our modern eyes, because larger or of somewhat different form; but to say that they are really distinct species from their modern representatives, or to say that no human being ever saw them alive — that is, that they were not contemporary with man — is to make statements utterly incapable of proof. Up to about the year 1869, it was stoutly maintained that man had never seen *any* of these fossil forms alive. But no one now maintains this view, for human remains have since been found along with undisturbed fossils of the Pleistocene, or even middle Tertiaries, while the paintings on the cave walls of southern France seem conclusive that they were made by men who were perfectly familiar with the elephant (mammoth) and the other animals there depicted. The same remark applies to the recently discovered drawings on the walls of the Hava Supai Cañon, Arizona, which depict a dinosaur and an elephant, to say nothing of ibexes, the last of which are not found in North America either in the living state or as fossils. Quite evidently, the ones who made these drawings, including that of the dinosaur,

must either have seen these animals alive, or they must have received a good description of them from some other human being who had seen them alive. Hence the only question now is — and it is the supreme question of all modern geology — WITH HOW MUCH OF THAT ANCIENT FOSSIL WORLD WERE THESE EQUALLY FOSSIL MEN ACQUAINTED? If man lived in "Pliocene" or perhaps "Miocene times," when a luxuriant vegetation was spread out over all the arctic regions, what possible evidence is there to show that his companions, the rhinoceros, the hippopotamus, the mammoth, etc., were not also living then and browsing off just such plants, when the arctic frosts caught them in the grip of death, and put their "mummies" in permanent cold storage for our astonishment and scientific information? Things that are equal to the same thing are equal to one another; why should not the plants and animals contemporary with the same creature, man, be just as truly contemporary with one another? If man was contemporary with the Miocene plants, and the Pleistocene mammals were contemporary with man, what is there to forbid the idea that the Pleistocene mammals and the middle Tertiary flora were contemporary with each other?

For nearly half a century, geologists have never had the courage to face this problem fairly and squarely, with all preconceived prejudices about uniformity cast aside. Is it possible that all the plants and animals of the Tertiaries and the Pleistocene really may have lived together in the same world after all? But the trouble would then be that, with

this much conceded, the whole "phylogenic series" would tumble with it, and become only the taxonomic, or classification, series of that ancient world with which these fossil men were acquainted. For if no single kind of fossil can be proved to be intrinsically older than other kinds, and man is found fossil as truly as any other form of plant or animal, how are we to escape the conclusion that *this whole fossil world was a unit,* and that these fossil men were contemporary with one type of life as truly as with another, or, in other words, contemporary with all alike? To appropriate the words of one who has done much to clear the ground for a common-sense study of geology, I know of nothing against such an idea save "the almost pathetic devotion of a large school of thinkers to the religion founded by Hutton, whose high priest was Lyell, and which, in essence, is based on *a priori* arguments like those which dominated medieval scholasticism and made it so barren."[5]

V

It was one of the cardinal principles of the early history of geology that *all* the forms of life found in the geologic strata were extinct. Gradually the evidence became overwhelming, and it was admitted that a few of the mollusks were possibly the same as the very similar-looking ones now living. But as for the great mass of the invertebrates, and also re-

[5] "The Glacial Nightmare and the Flood," Howorth, Preface, pp. 20, 21.

garding the vertebrates and the land mammals, it is astonishing how long this prejudice about "extinct species" continued to survive.

Here is the very positive statement of Edward Hitchcock, president of Amherst College, and one of the leading exponents of the science of that day. These words were written in 1851, though the book in which they are found bears the date of 1861.

> "Among the thirty-five thousand species of animals and plants found in the rocks, very few living species have been detected; and even these few occur in the Tertiary rocks, while in the groups below, not less than six miles thick, not a single species now on the globe has been discovered. Hence the present races did not exist till after those in the Secondary [Mesozoic] rocks had died."[6]

President Hitchcock gives this as one of the "Settled Principles of Geology," which is the heading of the chapter in which this precious piece of information is contained.

Echoes of this old dogmatism about all the species found in the Paleozoic and the Mesozoic rocks being "extinct," are heard even to-day; for while it is admitted that many *genera* found among these rocks are similar to those now alive, and although it is often candidly admitted that various specimens found as fossils are astonishingly like their modern representatives, yet the specific identity of the ancient and the modern forms is never admitted even to-day, so far as the Mollusca and Brachiopoda and other invertebrates are concerned.

[6] "The Religion of Geology," p. 23.

The following remarks are taken from a little work by Geoffrey Smith, and published by the Cambridge University Press, and they throw various interesting side lights on the problem which we are here considering:

"There is a form of brachiopod called *Lingula,* which burrows in the sand between tide marks or at a shallow depth, and is found in certain localities off the coasts of many tropical and temperate countries. On certain parts of the coasts of

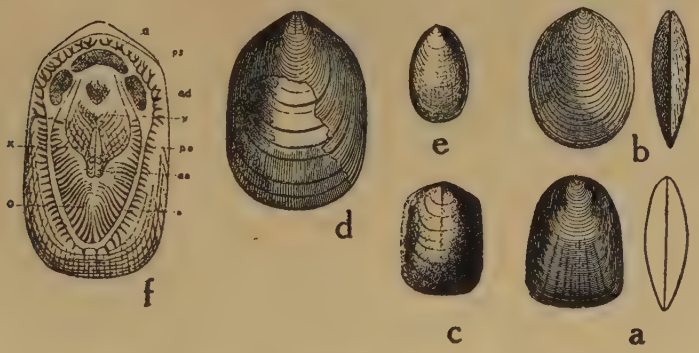


FIG. 51. A Group of Paleozoic Lingulas. (After Dana.)

northern Canada the cliffs are formed of rocks belonging to a stratum lying at the base of the Cambrian, and the very oldest in which fossils of any description are to be found. In the cliffs it is possible to chip out very perfect fossil shells of the *Lingula* which lived on this coast in the Pre-Cambrian period; from the sand at the foot of the cliffs we can dig out living specimens of *Lingula;* and if we examine the fossil shells and those of the living animal with the minutest care, we would not be able to detect the smallest difference, down to the finest striæ, between them."[1]

[1] "Primitive Animals," pp. 90, 91.

One can not help calling to mind the fact that Lyell proved the "late" Tertiary beds of Italy and other parts of the Mediterranean border to be very modern, because the shells in the rocks on the land were closely like those in the neighboring waters. But if this is a good rule, what about these rocks which contain these shells of *Lingula?* Why are not these Cambrian beds of northern Canada, containing these shells of *Lingula* exactly like the shells in the neighboring waters, just as modern as the Tertiary beds of Italy?

Baron Cuvier's work in the line of comparative osteology has never been surpassed, perhaps never equaled since, and he is said to have been "the greatest naturalist and comparative anatomist of that, or perhaps of any time."[8] Yet he maintained till the last that all those which we now call the Pleistocene mammals were distinct species from the modern ones; and it is only of recent years and with extreme reluctance that many of them have been admitted to be identical with the ones now living. All of which tends to show how unreliable are those assertions commonly found in the textbooks to the effect that all the "species" of the so-called "older" rocks are extinct. It is only with hesitation that such specific distinctions are surrendered even to-day, though during the last few decades a steady progress has been made in bringing the paleontology of the higher vertebrates into line with our increased knowledge of zoölogy, thus breaking down many of the specific distinctions

[8] "Evolution and Religious Thought," Le Conte, pp. 33, 34.

which have long been maintained between the fossils and the living forms. Even the mammoth has been found to have so many characters identical with the modern elephant of India, and so complete a gradation exists between the two types, that Flower and Lydekker acknowledge that the transition from one to the other is "almost imperceptible," and express a doubt whether they "can be specifically distinguished" from one another.[9]

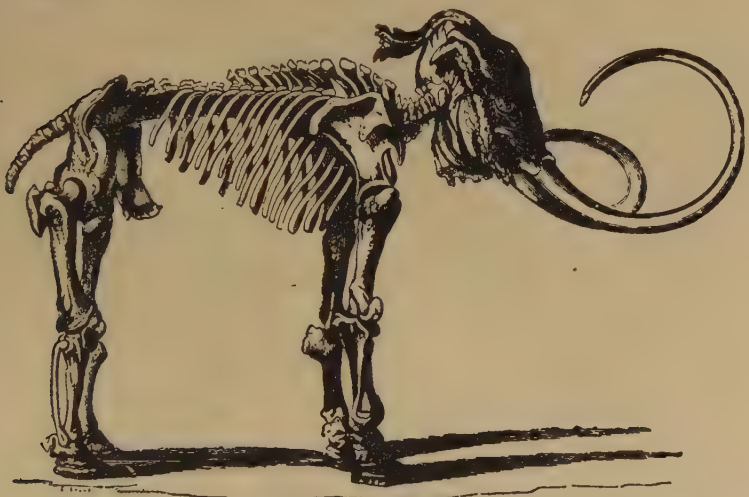


FIG. 52. Skeleton of mammoth (*Elephas primigenius*). (After D'Orbigny.)

But the extreme reluctance with which anything like a confession of this fact leaks out in our modern literature can be readily understood when we try the hopeless task of splicing the environment of the modern elephant with that of the ancient on any basis of uniformity.

[9] "Mammals, Living and Extinct," pp. 428, 429.

VI

Zittel gives us a peep behind the scenes, which helps us to appreciate the value of a percentage of "extinct" species as a test of the age of a rock deposit.

He pictures the uncritical work of the earlier writers on fossil botany, until August Schink (1868-1891)

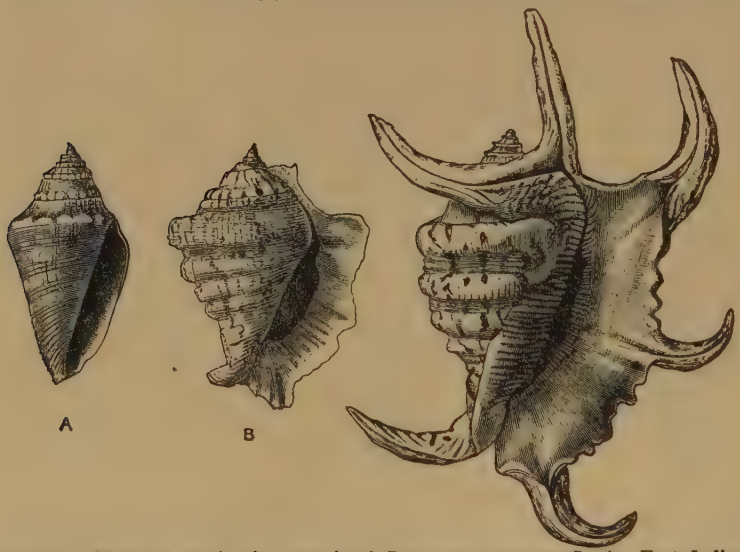


FIG. 53. Three stages in the growth of *Pteroceras rugosum* Sowb., East Indies, showing the development of the "fingers." (After A. H. Cooke, in "Cambridge Natural History.") If these were found fossil, how natural it would be to place them not merely in separate species, but in distinct genera!

made a great reform in this science; and Zittel declares that "now the author of a paper on any department" of fossil botany "is expected to have a sound knowledge" of the systematic botany of recent forms. But he adds, "It can not be said that paleozoölogy [the science of fossil animals] has yet arrived at this desirable standpoint."

But he justifies this charge of want of confidence by saying:

"Comparatively few individuals have such a thorough grasp of zoölogical and geological knowledge as to enable them to treat paleontological researches worthily, and there has accumulated a dead weight of stratigraphical-paleontological literature wherein the fossil remains of animals are named and pigeonholed solely as an additional ticket of the age of a rock deposit, with a willful disregard of the much more difficult problem of their relationships in the long chain of existence.

"The terminology which has been introduced in the innumerable monographs of special fossil faunas in the majority of cases makes only the slenderest pretext of any connection with recent systematic zoölogy; if there is a difficulty, then stratigraphical arguments are made the basis of a solution. [That is, distinct specific or even distinct generic names are given to the fossils.] Zoölogical students are, as a rule, too actively engaged and keenly interested in building up new observations to attempt to spell through the arbitrary paleontological conclusions arrived at by many stratigraphers, or to revise their labors from a zoölogical point of view."[10]"[11]

Doubtless this scathing impeachment of the common mania for creating new names for the fossils has especial reference to the case of the lower forms of life. For if, in spite of the brilliant and withal

[10] In the case of living forms, this mania for multiplying new specific names has met with many a sharp rebuke from our best scientists; and it is a great pity that the same rational view of the matter is not consistently extended backward through the whole long line of the fossil forms. Thus David Starr Jordan gives us a picture of what a battle it has been to keep the list of fishes from multiplying unduly: "In our fresh water fishes, each species on an average has been described as *new* from three to four times, on account of minor variations, real or supposed. In Europe, where fishes have been studied longer and by more different men, upwards of six or eight nominal species have been described for each one that is now considered distinct." ("Science Sketches," p. 99.) And again, "Thus the common Channel Catfish of our rivers has been described as a *new species* not less than twenty-five times, on account of differences real or imaginary, but comparatively trifling in value." (Id., p. 96.)

[11] "History of Geology," pp. 375, 376.

careful work of Cuvier, Owen, Wallace, Huxley, Ray Lankester, and Leith Adams, with numerous others that might be mentioned, there are still grounds for such grave doubts of the values of specific distinctions in the case of the mammals, whose general anatomy and life history are so well known, and whose almost countless variations are so well studied out, what must be the confusion and inaccuracy in the case of the lower vertebrates, and especially of the invertebrates, whose general life-history in so many instances is so dimly understood, and the limits of their possible variations absolutely unknown? (See Figs. 50, 53.) Remembering all this, what is our amazement when we read, in this same volume by Professor Zittel,[12] that the tendency among many modern writers, in dealing with these lower forms of life, is toward the erection of the closest possible distinctions between genera and species, until recent paleontological literature is fairly inundated with new names; and all this with *the purpose,* unblushingly avowed, of "enhancing the value" of such distinctions *as a means of determining the relative ages of strata,* and to "bring the ontogenetic and phylogenetic development" of the various forms "into more *apparent* correspondence." I do not exaggerate in the least, as the reader may see by referring to Zittel's book; though not wishing to make my readers "spell through" another quite technical paragraph, I have refrained from a lengthy quotation.[13]

[12] Pages 400, 403, 405.

[13] The following regarding Rafinesque, an early naturalist of the Eastern States, is too pertinent to be omitted in this connection. "He once

But surely we have here a most amazing style of reasoning. It is another clear case of first assuming one's premises, and then proving them by means of one's conclusion. The method here employed seems about like this: First assume the succession of life from the low to the high as a whole; then in any particular group, as of brachiopods or mollusks, decide the momentous question as to which came first and which later in "geological time" by comparing them as to size, shape, etc., with the live modern individual in its embryonic development from the egg to maturity; and lastly, take the *results* of this alleged chronological arrangement to prove *just how* the modern forms have evolved. It is a most striking example of how otherwise intelligent men may be hypnotized by a theory into blind obedience to its suggestions and necessities.

Some years ago, when I was first beginning to study this subject, I had occasion to write to one of my teachers, a well-known geologist, about a Lower Cambrian mollusk that appears strikingly like a modern species. I give on the following page an extract from his reply, which bears directly upon this point. I withhold the name, but I may say that the author's work on the Paleozoic fossils is recognized on both sides of the Atlantic.

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sent for publication a paper seriously describing, in regular natural-history style, twelve new species of thunder and lightning which he had observed near the Falls of the Ohio." (David Starr Jordan, "Science Sketches," p. 165.) Evidently many modern zoölogists and botanists are still somewhat Rafin*esque* in their methods; while the paleontologists are all imitators of this absurd precedent, handed down from the days of Cuvier and "Strata" Smith.

"Some geologists make it a point to *give a new name* to all forms found in the Paleozoic rocks; that is, a name different from those of modern species. I was taken to task by a noted paleontologist for finding a *pupa* [a kind of land snail] in Devonian beds; but I could not find any point in which it differed from the modern genus."

Of about the same import are the following remarks by Angelo Heilprin: "It is practically certain that numerous forms of life, exhibiting no distinct characters of their own, are constituted into distinct species for no other reason than that they occur in formations widely separated from those holding their nearest kin." The real reason at the bottom of such a proceeding, he freely confesses, "is based upon the assumption that no species, after it once became extinct, ever again came into existence." Hence, when a seemingly identical species *reappears in a widely separated formation,* or is found alive in the modern world, a new name is always given it, to avoid the difficulty of having it *skip all the intervening ages.* He clearly indicates that such things ought not to be done, and that similar forms, wherever found, ought to be classed together as the same species, no matter if it does involve the absurdity of these species' skipping long sections of the geological series. He gives a large number of examples of such skipping among the invertebrates; but doubtless even he, expert conchologist though he was, became discouraged in attempting to "spell through" the flood of new names referred to by Zittel, for he concludes by the remark:

"It is by no means improbable that many of the older genera, now recognized as distinct by reason of our imperfect

knowledge concerning their true relationships, have in reality representatives living in the modern seas.''[14]

Such disclosures speak volumes for those able to understand, and lead one to receive with a smile the familiar assertion that all the species of the Paleozoic and other ''older'' rocks are extinct. And we can now form a truer estimate of the high scientific accuracy of Lyell's ingenious division of the Tertiary beds, according to the percentage of living or ''extinct'' mollusks which they contain.

VII

Among naturalists and even among systematists, there have always been the ''splitters'' and the ''lumpers,'' the former tending to multiply species by founding them on minute differences real or imagined, the latter looking upon the minute differences as being merely marks of varieties, and being quite willing to include within one species all forms which we have reason to believe are of common origin within modern times, even though we are able to find marked differences between them, and even though these differences persist and the form breeds true to type.

The new world of fact that has been opened up before us under the guidance of Mendelian breeding, has abundantly justified the ''lumpers'' in their broader and more liberal views; for, in great numbers of instances, new kinds have been produced by experimental breeding which are apparently just as deserving of specific recognition as thousands of

[14] ''The Geographical and Geological Distribution of Animals,'' pp. 103, 104, 207, 208.

"species" now listed in our catalogues. But after all, breeding experiments can be actually carried out among only a very few of the great groups of the animal kingdom. The great majority of the animals are hopelessly beyond the reach of any such methods of research. And yet, if we are willing to be taught from those examples which we can work and experiment with, why might we not reasonably and with a high degree of scientific accuracy extend our enlarged knowledge to those other orders, such as the Mollusca, the Brachiopoda, the Crinoidea, and the Foraminifera, where it is impossible to test out these principles which have been so clearly demonstrated in some of the other great groups of living creatures? But what a revolution would thus be produced, not only in our views of the living forms, but especially in our views of the fossil world!

The French school of conchologists are notoriously "splitters"; but there are some elsewhere who have caught the spirit of a broader view, and who see, in the minute distinctions upon which many species and even genera are based, only the natural fluctuations which are exhibited by all nature in response to varying environments.

For example, F. P. Marrat holds that the great genus of mollusks, known as *Nassa,* with more than one hundred fifty listed species, is, in reality, only one shell, or one species, after all, though exhibiting such a wide variety of forms.[15]

[15] "Cambridge Natural History," Vol. 3, p. 82.

But if similar methods could be carried out through the whole field of living forms, both of plants and animals, and if then similar methods could be extended to the fossils, what an inspiration of common sense would be infused into this subject of comparing the fossils with their modern living representatives!

For nearly two generations the embryonic development of the modern individual has been considered the guide to indicate the geological or historical sequence in which the order or the class *must* have developed. And, fortunately for the paleontologists, the strata have usually been so very accommodating that they could be pushed up or down very easily, so as to make them conform to this required order. To illustrate: It has been found that the ammonites have a pattern on the shell marking the internal sutures which increases gradually in complexity as the animal develops, the young ones having a simple pattern, and the older ones having a much more complex pattern. Therefore (the paleontologists have reasoned) those species which in maturity have a comparatively simple pattern must have lived *earlier* in the geological series than those which, at maturity, have a very complex pattern. And they have arranged the fossil ammonites accordingly. Very simple, to be sure; but what certainty is there about *the results* founded on such methods? And yet there is not a class or an order or a family throughout the whole animal kingdom,— nor throughout the plant kingdom either,—

which has not had its fossils classified largely on the same general principle.

True, we have had a few timid protests against such methods, but they are of little use; the custom goes on just the same. If we were merely making a taxonomic series (as I claim the current geological series really is), this method would be all right. But to claim any scientific value for such a classification as a *real historical series,*— well, I can not understand how such methods have held their vogue so long.

Here are some sensible words taken from the first volume of the "Cambridge Natural History," written by E. W. MacBride, the eminent embryologist:

> "The attempt to construct detailed phylogenies [geological lines of succession] involves the assumption that one set of structures, which we take as the mark of the class, has remained constant, whilst others which are regarded as adaptive, may have been developed twice or thrice. As the two sets of structures are often of about equal importance, it will be seen to what an enormous extent the personal equation enters in the determination of these questions."[16]

The reasons here set forth, the dependence upon the "personal equation" of this subjective work, are undoubtedly the reasons why in the Crinoidea, as MacBride says, "there is no agreement amongst experts as to how they should be classified," and why the workers in England, Germany, and America have "come to fundamentally different conclusions."[17]

But, paradoxical as it may sound, this same dependence upon the "personal equation" has brought

[16] Page 460.
[17] Pages 594, 589.

unity among paleontologists on many points where the embryonic development is clear; for they are all agreed to follow this as the scarlet thread to guide them through the maze. In such a case they all follow like sheep, just because it is wholly a matter of theory, and a theory with an entirely subjective foundation.

FIG. 54. *Terebratula sella.* (Lower Greensand.) *d,* Deltidium; *f,* foramen.

Another enlightening sentence is the very last one in Volume 3 of "The Cambridge Natural History," regarding brachiopods:

"When we come to deal with specific differences, we find *frequently such a host of intermediate varieties that the* separation of many species, as in the case of Mesozoic *Terebratulidæ,* is to a large extent arbitrary and artificial."[18]

And yet, these same *Terebratulidæ,* with many others of the Brachiopoda, are used as "index fossils," as the infallible tickets with which to identify and classify the strata wherever they happen to occur.

All these uncertainties and all these absurdly unscientific methods must be added to the indictment already entered against the objective validity of the geological time-scale; for they constitute another plain case of unfairly manipulating the facts to suit the needs of the evolutionary theory of life.

VIII

At present, it must be owned that we have no real scientific and judicial comparison of the fossil invertebrates with their living representatives; the whole

[18] F. R. C. Reed.

subject is in utter chaos. As geologists have so long worked under the dominating prejudice that all the Mesozoic and Paleozoic genera and species ought to be "extinct," it is only with the most extreme reluctance that these long-established distinctions between the ancient and the modern kinds are given up. In great multitudes of instances, the close similarity between the ancient and the modern forms is freely acknowledged; but *how are the old names to be discontinued?* There also arise the questions of priority, and which name is to be retained, the fossil one or the living one?

If it were merely a matter of only a few dozen genera, or species, it would be a comparatively simple matter. But when literally thousands of names are thus involved in suspicion and need a complete revision, and when these names are scattered throughout the whole of the lower orders of the animal kingdom, we can see what an enormous task it involves, to say nothing of the dark uncertainty which this condition of affairs throws over the whole subject of extinct species. What possible scientific value can attach to the plan of arranging certain strata in alleged chronological order, according to the percentage of "extinct" and "living" species which they may contain?

Because of the absurdly unscientific character of this argument based on an alleged proportion of "extinct" species, it follows that all the chronological distinctions based on such an argument have no scientific value. Hence the life-succession theory as a whole can find no support from these alleged distinc-

tions between "extinct" and "living" species, just as we have already seen that this evolutionary scheme of life is without a vestige of support from the long-popular fable about the "invariable" order in which the fossils occur.

All we need in both instances is an honesty which will clearly differentiate between facts and speculations; and the life-succession theory must go to the limbo of other discarded hypotheses.

The geological theory of definite successive forms of life in an invariable order of sequence has not a single large fact to confirm it in the realm of nature. It was not born of any large acquaintance with the fossil world, but was the subjective product of the hasty snap judgment of the early collectors, who were childishly illogical and ignorant of great multitudes of facts which are now matters of common knowledge.

CHAPTER VIII

Skipping: Fact Number Five

I

We are now able to appreciate another absurdity involved in the life-succession theory, the discussion of which grows naturally out of the subject of extinct species.

As preliminary to the subject here to be presented, we must bear in mind that the present arrangement of the fossils in alleged chronological order, as well as the naming of thousands of typical specimens, was all well advanced while as yet little or nothing was known of the contents of the depths of the ocean, or even of the land forms of Africa, Australia, and other foreign countries. In most of the important groups of both plants and animals, the detailed knowledge of the fossil forms *preceded the knowledge of the corresponding living forms,* just as Zittel says that the theories of the igneous origin of the crystalline rocks "had been laid without the assistance of chemistry" and the knowledge of the microscopic structure of these rocks.[1] On pages 128-137 of his "History," this author shows that, up to 1820, little or nothing of a scientific character was known of any of the classes of *living* animals save mammals, while the geological series was all fixed long *before*

[1] "History," pp. 327, 341.

this date.[2] During the last half century, however, the progress of science has been steadily showing case after case where families and genera, long boldly said to have been "extinct" since "Paleozoic times," are found in thriving abundance and in little altered condition in unsuspected places all over the world. And the point for consideration here is the manifest absurdity of these inhabitants of the modern seas and the modern land *skipping* all the uncounted millions of years from "Paleozoic times" down to the "recent"; for though found in profuse abundance in these "older" rocks, not a trace of many of them is to be found in all the "subsequent" deposits.

II

The proposition here to be considered and proved, I shall venture to formulate as follows:

There is a fossil world and there is a modern living world, the two resembling one another in various details as well as in a general way; but to get the ancestral representatives of many modern types,— for example, an unknown number of invertebrates, with other forms of animals and plants,— we must go clear back to the Mesozoic or the Paleozoic rocks, for they are not found in any of the "more recent" deposits.

I have already remarked that the blending of the doctrine of life-succession with that of uniformity, must inevitably have given birth to the evolution

[2] Comte, in his classification of the sciences, issued in 1820, denied a place to geology altogether, because, he said, it was not a distinct science at all, but only a field for the application of the sciences.

theory; for it is evident that the succession from the low to the high could only have taken place by each type's blending with those before and those after it in the alleged order of time. That such is *not* the testimony of the rocks, even when arranged with this idea in view, is too notorious to need any words of mine; for by many[3] it has been considered the "greatest of all objections" to the theory of evolution.[4]

This abruptness in the disappearance of "old" and the first appearance of "new" forms, has brought into being that "geological scapegoat," as James Geikie has called the doctrine of the imperfection of the record. But Dawson has well disposed of this argument in the following words:

> "When we find abundance of examples of the young and old of many fossil species, and can trace them through their ordinary embryonic development, why should we not find examples of the links which bound the species together?"[5]

But it is equally evident that each successive formation of the series ought to contain, in addition to its own characteristics or "new" species, *all the older forms which survive into any later deposits, or are now to be found living in our modern world.* Such, no doubt, was the idea of those of the early geological

[3] See Le Conte, "Evolution and Religious Thought," p. 253. Note also the following from Charles Darwin himself: "Geology assuredly does not reveal any such finely graduated organic chain; and this, perhaps, is the most obvious and gravest objection which can be urged against my theory." ("Origin of Species," 1859, p. 342.)

[4] Not only is this fact an argument against evolution, but its chief weight lies against the current geological theory of successive ages. Yet it has been so often mentioned in writings on this subject, that there seems to be no necessity for doing more than refer to it here.

[5] "Modern Ideas of Evolution," p. 35.

explorers who discarded Werner's onion-coat theory, and they tried to arrange their series accordingly. This reasonable demand is still recognized as good; and Dana alludes to the principle when he attempts to show how strata might be discovered and "proved" to be older than the present Lower Cambrian rocks.[6]

It is, I say, still recognized *in theory* that the "younger" deposits ought to contain samples of the "older" types that were still surviving, in addition to their own characteristic species; but with the progress of geological discovery, it has long since been found that such an arrangement is utterly impossible. Indeed, it would almost seem as if modern writers had forgotten the principle altogether.

For there are many kinds of invertebrates, both terrestrial and marine, alive in comparative abundance in our modern world, whose fossils are found only in some of the very oldest rocks, and have skipped all the rest! Others which date from "Mesozoic times" are wholly absent from the Tertiary rocks, though found abundantly in our modern world. This I regard as another very crucial test of the rationality of this idea of a life-succession.

III

Of course, there are certain limitations which must be borne in mind. If we find a series of beds made up largely of deep-sea deposits, we can not reasonably expect to find in them examples of all the land forms of the preceding "ages" which then survived, nor

[6] "Manual," pp. 487, 488.

even of the shallow-water types. Nor, conversely, can we demand that, in beds crowded with the remains of the great mammals and plants, and thus probably of fresh- or shallow-water formation, we ought to find examples of all the marine types still surviving. We now know that each level of ocean depth has its characteristic types of life, just as do the different heights on a mountain side. This doctrine of "rock facies" was, I believe, enunciated first in 1838. Edward Forbes also did much for this same idea, showing how, at the present time, certain faunas are confined to definite geographical limits and particular ocean depths. Jules Marcou, about 1848, applied this principle to the fossils, and showed how such distinctions must have prevailed during geological time.

Here it seems that we are at last getting a refreshing breath of true science. But if the idea is carried out honestly and in its entirety, how shall we assure ourselves that in the long ago very diverse types of fossils, for example, graptolites and nummulites, or even trilobites and mammals, *could not have been contemporary with one another?* This principle of "rock facies," if incorporated into the science in its early days, would have saved the world from a large share of the nonsense in our modern geological and zoölogical textbooks.

But in answer to any pleadings about the imperfection of the record, or any protest about the injustice of judging all the life-forms of an "age" by a few examples of local character — that is, of fresh, shallow, or deep water, as the case may be — the very obvious

retort is, *Why, then, is a time-value given to such local and fragmentary records?* Why, for example, should the Carboniferous and associated formations be counted as representing *all* the deposits made in a certain age of the world, when we know from the Cambrian and the Silurian, and also from the alleged "subsequent" Jurassic, that there must have been vast open-sea deposits formed contemporaneously?

As Dana expresses it:

> "The Lias and Oölyte of Britain and Europe afforded the first full display of the marine fauna of the world since the era of the Subcarboniferous. Very partial exhibits were made by the few marine beds of the Coal Measures, still less by the beds of the Permian, and far less by the Triassic. The seas had not been depopulated. The occurrence of over 4,000 invertebrate species in Britain in the single Jurassic period is evidence, not of deficient life for the eras preceding, but of extremely deficient records."[1]

Surely these words exhibit the "phylogenic series" in all its native, unscientific deformity. It is *because* the Coal Measures, the Permian, and the Triassic are necessarily "extremely deficient records" of the total life-forms then in the world, that I am writing this chapter, and this book. But it seems like perverseness to plead the imperfection of the record, and still refuse the *evidently complementary deposits* when they are presented. If, as this illustrious author says, "the seas had not been depopulated," what would he have us think they were doing? Were they forming no deposits all these intervening ages that the Carboniferous, Permian, and Triassic

[1] Id., p. 776.

were piling up? Were the fishes and the invertebrates all immortalized for these ages, or were they, when old and full of days, translated to some supermundane sphere, thus escaping deposit in the rocks? Did the elements continue in the *status quo* all these uncounted millions of years? And if so, how did they receive notice that the Triassic period was at last ended, and that it was time for them to begin work again? I do not like to appear trivial; but these questions serve to expose the folly of taking diverse, *local,* and *partial* deposits, and attaching a chronological value to each of them separately, and then pleading in a piteous, helpless way about the imperfection of the record.

IV

Yet I can not promise to present a tithe of the possible evidence, because of two serious handicaps. First, the ordinary literature of paleontology is silent and meager enough in all conscience, even though the bare fact may be recorded that a "genus" of the Cambrian or Silurian is "closely allied" to some genus now living. It may even be admitted that "according to some it is not generically distinct from the modern genus" so-and-so; but the authors never descend below the "genus," and in most cases forget to tell us whether or not it occurs in other "later" formations, though the presumption is that it does not, but has skipped all the intervening ages, or it would hardly be named as a characteristic type of the formation in which it occurs.

But this disadvantage, serious though it be, is scarcely worth speaking of when we remember that "some geologists make it a point to give a new name [that is, a new generic name] to all forms found in the Paleozoic rocks"; or, as Heilprin says, "it is by no means improbable that many of the older genera, now recognized as distinct by reason of our imperfect knowledge concerning their true relationships, have in reality representatives living in the modern seas."[8]

Hence I have no reluctance in saying that, in the present confused state of zoölogy and paleontology, it is utterly impossible for anyone to find out the truth as to how many hundreds of these "genera" of the Paleozoic rocks may have survived to the present, though having skipped perhaps all the formations of the intervening millions of years. I doubt not that the number is enormously large; but as no one has yet attempted to "spell through the arbitrary paleontological conclusions" scattered through the literature, to repeat the words of Zittel, we can depend on only a few though striking examples that lie on the open pages of the ordinary textbooks.

V

With the progress of geological discovery, some of the difficulties and absurdities along this line have been removed or disguised, while still others have been brought out into clearer prominence. That is, a few stray examples have been found here and there

[8] "Geographical and Geological Distribution," pp. 207, 208.

to save us from being obliged to say that a certain genus, or family, or order skips two or three of the successive systems; but on the other hand, many genera or families have been found in modern times in unexpected places, though these genera or families had long been supposed to be really extinct for many geological periods.

As an example of the first of these conditions, where great difficulties have been removed with the further progress of the science, we have the following from Hugh Miller, which represented the best knowledge of the science when it was written, in 1857:

"No true fossil palms have yet been detected in the great Oölitic and Wealden [Jurassic and Cretaceous] systems, though they certainly occur in the Carboniferous and Permian rocks, and are comparatively common in the earlier and middle Tertiary formations. Much can not be founded on mere negative evidence; but it would be certainly a curious circumstance should it be found that this graceful family, first ushered into being some time in the later Paleozoic periods, was withdrawn from creation during the Middle Ages of the earth's history, to be again introduced in greatly more than the earlier proportions during the Tertiary and recent periods."[9]

This difficulty has been obviated by quietly removing from the Paleozoic Group any strata which happen to contain fossil palms, placing them in the late Cretaceous or early Tertiary, where they more naturally belong. Other similar difficulties of the earlier classification have been remedied in the same way. In other instances also a stray example has been found which saves the day, so that we no longer are

[9] "Testimony of the Rocks," p. 72; note.

confronted with so many patent examples of such skipping on the part of whole families, orders, and classes, as was formerly the case. Nevertheless, the difficulty still remains; and were it not that such great numbers of the fossils are still entombed in the grave of a disguising terminology, *invented for the very purpose of disguising the relationships between the ancient and the more modern forms,* we might fill a volume with a list of such skippings.

VI

The larger mammals, of course, can furnish us no examples, for the "age" in which they abounded is quite conveniently modern, and is separated from the present by no great lapse of time. Of the smaller marsupials, a number of jawbones have been found in the Jurassic and Triassic, one from the latter being strikingly like the living *Myrmecobius* of Australia. They are scarcely more numerous in the Cretaceous of America; while in the foreign rocks of this system, Dana says, "only one species had been reported up to 1894." Those strange, sad-eyed creatures called lemurs deserve a passing notice; for though now confined, as to their typical forms, to the island of Madagascar, their fossils seem as exclusively confined to the temperate regions of the New and the Old World. Flower and Lydekker enumerate about fifteen fossil species, and add that "it is very noteworthy that all these types seem to have disappeared from both regions with the close of the upper portion of the Eocene period."[10]

[10] "Mammals," etc., p. 696.

FIG. 56. A, *Neoceratodus forsteri*, Queensland; B, *Protopterus annectens*, Gambia; C, *Lepidosiren paradoxa*, Paraguay. The lozenge-shaped markings on the surface of B do not represent scales, but areas of the skin outlined by pigment cells. In a fresh specimen, the scales are completely invisible, as in C. (A, from Gunther; B and C, from Lankester.)

But this jump from the "Eocene period" to the present is as nothing compared with the secular acrobatics of some of the fishes and especially of the invertebrates. The living Heterodont, or Bullhead Sharks, (among which is the Port Jackson Shark, Fig. 55), of which there are four species found in the seas between Japan and Australia, seem to disappear with the Cretaceous, skipping the whole Tertiary epoch, as do also a tribe of modern barnacles which, as Darwin says, "coat the rocks all over the world

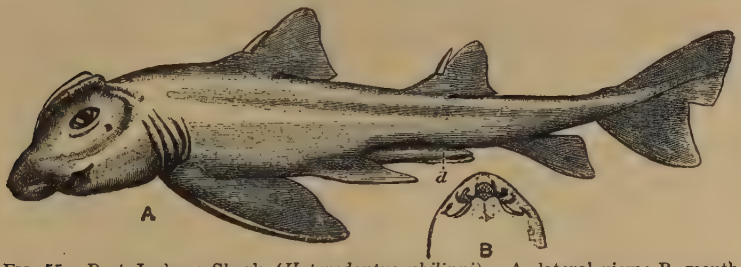


FIG. 55. Port Jackson Shark (*Heterodontus philippi*). A, lateral view; B, mouth and nostrils. *d*, Clasper. (From a specimen in the Cambridge University Museum, after T. W. Bridge.)

in infinite numbers." The dipnoans, or lungfishes (having lungs as well as gills, such as the *Ceratodus* and *Lepidosiren*), which are represented by several living species in Australia and South Africa, are the remains of a tribe found in whole shoals in the Carboniferous, Triassic, and Jurassic rocks, but not, so far as I know, in any of the subsequent rocks until the modern. The living *Ceratodus* (Fig. 56) was only discovered in 1870, and was regarded as a marvel of "persistence." On a pinch, as when his native streams dry up, this curious fellow can get along all

right without water, breathing air by his lungs like a land animal. If, in the meantime he was off on a trip to the moon, he must have "persisted" a few million years without either.

But his cousin, the *Polypterus* of the Upper Nile, has a still more amazing record, for he has actually skipped all the formations from the Devonian down to the modern; while the limuloids, or sea scorpions, have jumped from the Carboniferous down.

A tribe of Decapod crustaceans known as *Eryonidæ* are very common in the Triassic strata, and were long regarded as "among the oldest Decapoda known."[11] But a number of them were fished up by the "Challenger" naturalists, and were given the generic name of *Willemoesia*. And now we are told that "the genus *Willemoesia* is very widely distributed, being dredged up from below a thousand fathoms in the Indian Ocean, the Mediterranean, the North and the South Atlantic and the Pacific Oceans."[12]

The mollusks and the brachiopods would afford us examples too numerous to mention. How is it possible that these numerous families disappear suddenly and completely with the Mesozoic or even the "early" Paleozoic, and are not found in any "later" deposits, though alive now in our modern world? Parts of Europe and America have, we are told, been down under the sea and up again a dozen times since then; why should we not expect to find abundant remains

[11] Geoffrey Smith in "Cambridge Natural History," Vol. 4, p. 157.
[12] Id., p. 158.

of these "persistent" types in the Mesozoic and Tertiaries? Surely these feats of time-acrobatics show the folly of arranging *contemporaneous, taxonomic groups* in single file and giving to each a time-value.

The chalk points a similar lesson. It was not till the time of the "Challenger" expedition that the

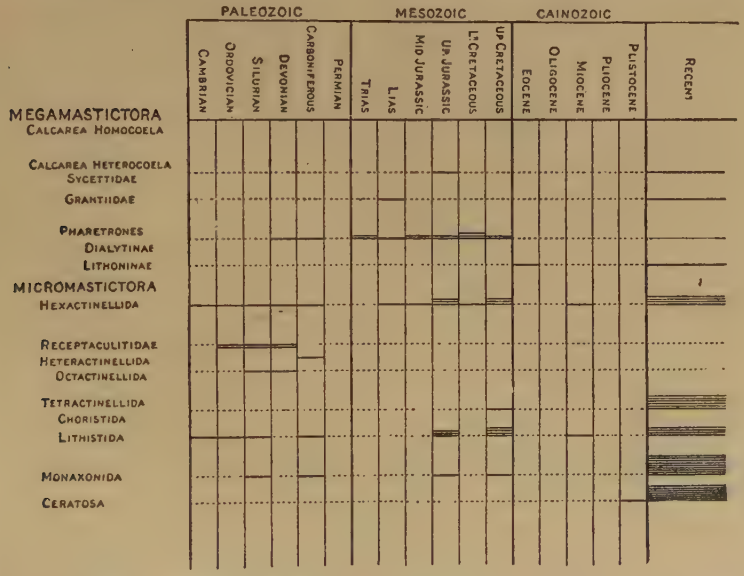


FIG. 57. Table to indicate distribution of Sponges in time. (After I. B. J. Sollas.) This is a photographic reproduction of the diagram given by this author in "The Cambridge Natural History." Unlike most diagrams of this kind, this sketch honestly shows in just what formations Sponges are found, as well as those that they skip. Comment is unnecessary.

modern deposits of Globigerina ooze (Fig. 65), made up of hundreds of species identical with those of the chalk, were known to be now forming over vast areas of the ocean floor. In the words of Huxley, these

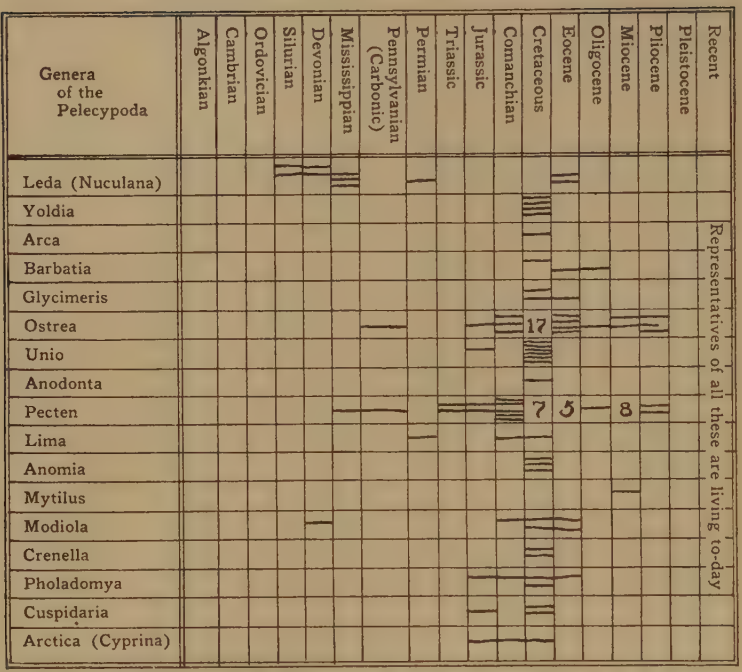


FIG. 58. Diagram illustrating the geological range of certain genera of the Pelecypoda, or Mollusks, illustrating "skipping." The horizontal lines represent occurrences; where the number is too large to be conveniently shown thus, figures are given instead. This diagram is compiled by the author from Grabau and Shimer's "North American Index Fossils."

modern species "bridge over the interval between the present and the Mesozoic periods."[13]

As for the siliceous sponges found in the chalk (see Fig. 57), which were such puzzles for the scientists during the first half of the nineteenth century because their living forms were unknown, the deep-sea investigations have solved the problem; for in 1877, Sollas demonstrated "the identity of their structure

[13] "Discourses Biological and Geological," p. 347.

with that of living Hexactinellids, Lithistids, and Monactinellids.''[14]

And yet, with all the vicissitudes of the continents during the ''millions of years'' since the Cretaceous age, there is, so far as I am aware, not a trace of either the chalk or the sponges in any of the ''subsequent'' rocks. Pieces of Cretaceous rock are, of course, found thus sporadically as bowlders, but there is no natural deposit of this kind. But in the light

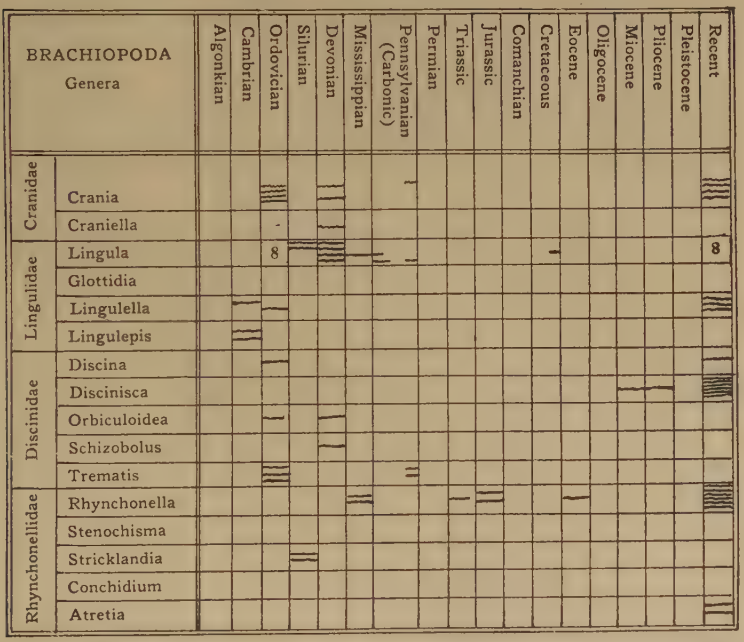


FIG. 59. Diagram illustrating "skipping" among the Brachiopods. The absurdity of the current theories as to the relative age of the various formations containing these Brachiopods is seen at a glance. Compiled by the author from Grabau and Shimer's "North American Index Fossils."

[14] ''History of Geology,'' Zittel, p. 388.

Orders	Silurian	Devonian	Carboniferous	Permian	Triassac	Jurassic	Cretaceous	Eocene	Oligocene	Neocene	Recent
Acari									34	2	#
Chelonethi									9		#
Anthracomarti			16								
Pedipalpi			2								#
Scorpiones	3		8						1		#
Opiliones									13		#
Areneae			2						211	15	#

FIG. 60. Table showing the geological range of the Arachnida. The figures indicate the number of species, as estimated in 1885. From Zittel's "Textbook of Palæontology," Vol. 1, p. 681. These figures are good illustrations of the phenomena of "skipping."

of these modern discoveries, why is not the chalk of "the white dear cliffs of Dover," full of modern living species as we now know it to be, just as "recent" a deposit as the "late" Tertiaries or the Pleistocene?

Here is a curious list of instances of skipping as given by Dana:

"A few land snails are found in the Carboniferous, but no land snails have been recognized from the Permian, Triassic, or Jurassic formations. In the Cretaceous they reappear, and from that time the series is substantially continuous. A few scorpions are found in the Upper Silurian; none have been recognized from the Devonian; but in the Carboniferous both scorpions and spiders occur. Both these groups appear to be missing from the Permian and from the

whole series of Mesozoic strata. They reappear in the Tertiary. Amphibians of the order Labyrinthodonts appear in the Subcarboniferous (or, probably, in the Devonian), and continue through the Triassic, possibly into the beginning of the Jurassic. The class of amphibians then remains unrepresented until a salamander appears in the Lower Cretaceous.''[15]

Since Dana wrote these words, two or three examples of fossil amphibians have been found in lucky places, so that the case at present, so far as I know, stands about as shown on the chart given on page 641 of "The New Geology," quoted from Williston.

Speaking of the shrimp, *Anaspides,* Geoffrey Smith says:

"It was evidently a dominant form of shrimp at the time the Coal Measures were being deposited, but it is not met with in more recent deposits, and we have no clue to its history

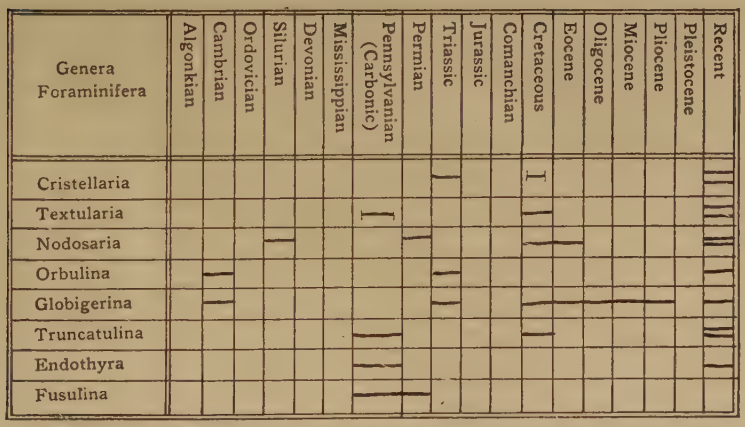


FIG. 61. Diagram illustrating "skipping" in the case of the Foraminifera. Diagrams like this and the others shown in accompanying figures, showing the Sponges, Brachiopods, Pelecypods, etc., could be compiled for every single group of the animals and plants.

[15] "Revised Textbook," p. 459.

FIG. 62. Jurassic crinoids. *Pentacrinus fasciculosus*, showing calyx with arm and part of stem. *c, c,* lateral and summit view of stem points. (After D'Orbigny.) *Apiocrinus roissyanus*, showing entire individual. The stem has been shortened. (After D'Orbigny.)

between the time that it peopled the Carboniferous seas and the present day when it survives in a few tarns and streams on isolated mountains in Tasmania."[16]

Another good illustration of the absurdity of the usual arrangement of the rocks is found in the echinoderms — crinoids, starfishes, sea urchins, etc. Of the latter, Prof. A. Agassiz found now alive in the deep waters of the West Indies four genera of echinids, or sea urchins, of the "later Tertiary," but twenty-four genera of the "early Tertiary," ten of the Cretaceous, and five of the Jurassic.[17]

But far from being uncommon, we know that similar discoveries have been in almost constant progress during the last half century. And were it not that "zoölogical students are," as Zittel says, "too actively engaged and keenly interested in building up new observations to attempt to spell through the arbitrary paleontological conclusions" found in the "dead weight of stratigraphical-paleontological literature," there is no telling what hosts of similar facts might be pointed to regarding the forms found in all the "older" rocks.

Of the starfishes and the serpent stars (*Asteridea* and *Ophiuroidea*), Zittel says: "It would seem that the Paleozoic 'sea stars' differed very little from those in the seas of the present age."[18] The crinoids (see Fig. 62) are found in great abundance in many of the Paleozoic rocks; while forms scarcely separable from the modern ones are found in the Jurassic, but

[16] "Primitive Animals," ed. 1911, pp. 52, 54.
[17] "Manual," Dana, p. 59.
[18] "History of Geology," p. 395.

so far as the textbooks tell us, are practically unknown in any of the "later" deposits. But over five hundred species of modern crinoids have been listed, these being grouped under 142 genera and 28 families. Great numbers of these are essentially identical with the Mesozoic fossil kinds.

FIG. 63. *Pleurotomaria adansoniana* Cr. and F., Tobago. x 1-3. This genus of Mollusks seems to have skipped from the Jurassic down. It was long supposed to be extinct. More than 1,100 fossil species have been described; but within the last generation, some twenty specimens, belonging to five species, have been discovered at great depths off Japan and the West Indies.

But what were these creatures doing since "Jurassic times," while the "pulsating crust" was putting parts of the continents under the sea for ages at a stretch? Why did they form no deposits during the Cretaceous, the Eocene, the Miocene, or the Pliocene age? Surely the absurdity of the present arrangement is evident to a child. During all these intervening ages, the climate of the globe continued of the same remarkable mildness, fossils of all these formations being found about as far north as explorers have ever gone. Did the crinoids and the corals suspend business from "Jurassic times" to the "recent" merely to accommodate a modern theory? Dana says that "the coral reefs of the Oölite in England consist of corals of the same group with

the reef-making species of the existing tropics";[19] and from this fact he argues that the mean temperature of the waters must have been about 69° F. But a luxuriant, warm-climate vegetation still continued in the arctic regions during the Cretaceous and the Tertiaries. How absurd to say that these corals built no reefs about the European coasts during all these ages! Or, to put the matter in another way: Consid-

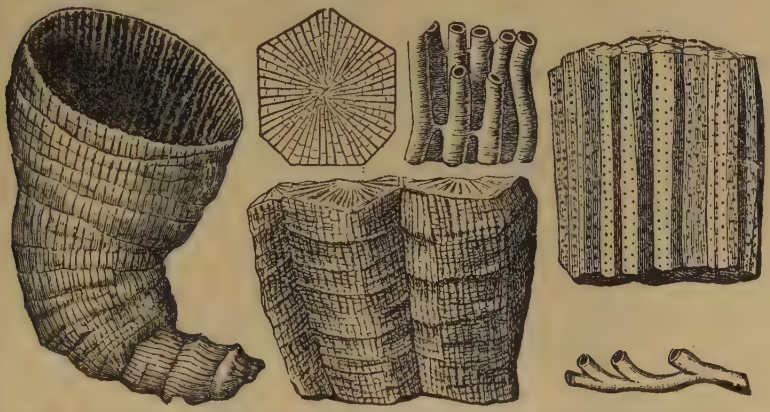


FIG. 64. Devonian corals. *Zaphrentis rafinesquii;* Cyathophylloid corals, as mentioned in the text; *Syringopora maclurii; Aulopora cornuta; Favosites goldfussi:* all of the Onondaga limestone, Middle Devonian. (After Dana.)

ering how many of their characteristic types are alive in our modern seas, why should we not say that the crinoidal or the coral limestones of the Mesozoic or the Paleozoic rocks are as recent as the nummulitic limestones of the Eocene or any late Tertiary deposits?

But let us try the tree ferns and cycads of the coal beds of the "older" rocks. In northern regions, they are not found "later" than the Triassic and

[19] "Manual," p. 793.

Jurassic; and doubtless the same holds good of the rocks in the tropics, where the modern species now live in fair abundance. But how did they come to shift to the tropics so many millions of years before the palms, etc., of the Tertiaries thought it time to do the same? The climate had not changed a bit; how did they come to scent the coming "Glacial age" so

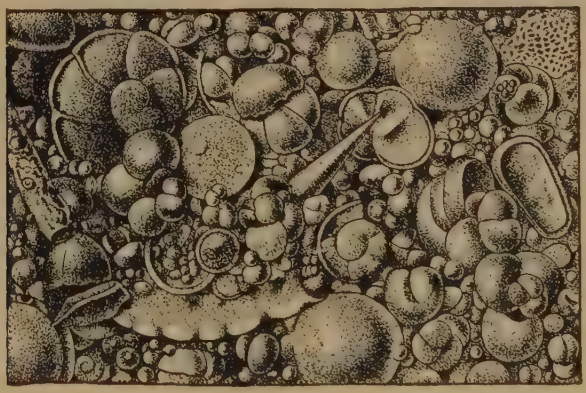


FIG. 65. Globigerina ooze. × 20. (After Murray and Renard.)

much earlier than their more highly organized fellows?

The "Challenger" expedition found some cyathophylloid corals, now building reefs, at the bottom of our modern ocean. The geologists had already assigned *the last* of them to the Carboniferous and Permian rocks, with the idea that they were extinct. But where have these fellows kept themselves during all the intervening ages, while the continents were deep under the ocean time and time again? or why are not the rocks containing their fossils as "recent" as any deposits on the globe?

VII

And so I might go on. There is hardly an order or even a family of the more common animals (save, of course, a few, such as the graptolites, the trilobites, and a few others) found in the "older" rocks which does not have its living representatives of to-day, and with, I believe, a fair proportion of the species identical; though in hundreds of cases, perhaps thousands, these species, genera, or even whole families or orders have somehow skipped all the intervening formations.

These things help to show that the geological classifications do not really represent successive ages, but are merely taxonomic classifications. These absurdities about skipping have come about because the whole fossiliferous series was all laid off, from the bottom to the top, many years before it was acknowledged that any really "modern" forms are to be found in the rocks. But such absurdities can only increase with further discoveries, and will cease only when we discard all time-values as attaching to particular types of life, and, beginning with the present, work back into the past to find where and how the fossils of all our modern species occur. In this way only can the science be reformed and the present absurdities eliminated.

VIII

But let us drop this method of studying our subject, and look at it from a slightly different point of view.

Thus Dana says that "the absence of lamellibranchs [pelecypods or true bivalves] in the Middle Cambrian, although present in both Lower and Upper, means *the absence of fossils from the rocks, not of species from the faunas.*"[20]

He puts this in italics, as I have done; for it is certainly a reasonable idea, and as A. R. Wallace says, "No one *now* doubts that where any type appears in two remote periods it must have been in existence during the whole intervening period, although we may have no record of it."[21] But what would be the result if we should extend this idea to its logical conclusion? It seems to be an effort to avoid one of the absurdities of the onion-coat theory, without, however, discarding that theory altogether.

In speaking of some corals and crinoids of the Devonian which "were absent" from some of the divisions of this formation because the conditions of the seas about New York "were unfavorable," Dana says that "they were back when the seas were again of sufficient purity."[22]

In his review of these formations, he enlarges on this subject:

"At the close of the early Devonian the evidences of clear seas — the corals and crinoids, with most of the attendant life — disappear, migrating no one knows whither. . . . With the variations in the fineness, or other characteristics of the beds, as H. S. Williams has illustrated, the species vary. . . . *The faunas of each stratum are not strictly faunas of epochs or periods of time, but local topographical faunas.* After the

[20] "Manual," p. 488.
[21] "Distribution of Life," p. 33.
[22] "Manual," p. 611.

Corniferous period, corals, crinoids, and trilobites still flourish somewhere, as before, but they are absent from the Central Interior until the Carboniferous age opens."[23]

IX

Here we are certainly getting a common-sense geology; but what would become of current theories if we should enlarge on this idea?

What if the gigantic dinosaurs of the Cretaceous or the equally marvelous mammals of the "early" Tertiaries of the Western States, described by Marsh and Cope, and the Pleistocene mammals of other parts of America and of Europe and northern Siberia, "are not strictly faunas of epochs or periods of time, but local topographical faunas"? What if the world-wide limestones of the Ordovician and the Silurian, and the no less enormous or widespread nummulitic limestones of the Eocene, extending from the Alps to eastern Asia, and constituting mountains ten, fifteen, or twenty thousand feet high — what if these are possibly *contemporaneous with one another?* What if the Coal Measures of Nova Scotia and Pennsylvania, and the Cretaceous and Tertiary lignites of Vancouver Island, Alberta, and the Western States, are not strictly floras of epochs or periods of time, but local topographical floras, and contemporary with each other?[24]

[23] Id., pp. 628, 629.

[24] This is only carrying the argument a little further than Huxley does when he says that "a Devonian fauna and flora in the British Islands may have been contemporaneous with Silurian life in North America, and with a Carboniferous fauna and flora in Africa. Geographical provinces and zones may have been as distinctly marked in the Paleozoic epoch as at present." ("Discourses," p. 286.)

In short, what possible means have we of proving, of any two distinct life assemblages, that they could not have coexisted on the earth in separated localities? Every candid man capable of appreciating scientific evidence must acknowledge that there is no such proof.

X

From all this, it must be evident that the fossil world is a unit; that the different kinds of life do not and can not mean successive ages, but that they are simply contemporary plants and animals all existing together in an older state of the world as we know it. The time and manner of the burial of these life-forms is a subject for further study, and will be considered in subsequent chapters.

Let us sum up all the net results of our studies. Rocks are called Devonian, Triassic, Eocene, or whatever, because of the fossils they happen to contain. When a new group of strata is found, its position in the series is determined by comparing its fossils with those of the formations already established, no matter what its stratigraphical relationship may be to the rocks above it or below. Hence these geological distinctions or classifications are purely artificial or conventional in character, and merely represent old taxonomic relationships, nothing more. In the face of the history of the idea, and of the purely haphazard way in which the various life-groups are now found to occur, as well as of the artificial and conventional way in which the members of these formations have been pieced together from scattered

localities, all claim about the results of these labors really representing a natural time-value appears so nonconsequential and fallacious to the student of other branches of science that it must soon make geology a laughingstock, unless we speedily discard these traditional time-values, and reconstruct our fundamental theories on a sure inductive basis in accordance with the sum total of modern discoveries. The recognized classifications will remain, though stripped of their time-values; and our science, instead of being deduced from postulated past conditions regarding an imaginary beginning of things, will content itself with starting with the present and the sum total of modern ascertained facts, and in their light reconstructing whatever is possible of past conditions by sound inductive methods.

By these methods of strict inductive science, we shall not be able to avoid the conclusion that our world has witnessed an awful aqueous catastrophe, and that back of this lies a direct and real creation as the only possible origin of the great families of plants and animals. In short, a strictly inductive and mature study of the facts of geology as known to modern science confirms in a very marvelous way the literal interpretation of the first chapters of Genesis, which a pseudo-criticism and the infant lispings of science supposed they had consigned to the realm of fable and myth.

PART TWO

Additional Facts for the Basis of a True Induction

CHAPTER IX

Graveyards

I

"The crust of our globe," writes a distinguished scientist, "is a great cemetery, where the rocks are tombstones on which the buried dead have written their own epitaphs." The reading of these epitaphs is the business of geology; and too often, as we shall see, the record is that of a violent and sudden death.

With the doctrine of geological *uniformity* as a theoretical proposition, I shall have little to say. At best, it is a pure assumption that the present quiet and regular action of the elements has always prevailed in the past, or that this supposition is sufficient to explain the facts of the rocks. In its more extreme form, it becomes an iron dogma, which shuts out all evidence not agreeable to its teachings. But in its essential nature, whether in its least or in its most extreme form, it is not approaching the subject from the right standpoint. It is not following the method of scientific research, but the method of lazy, scholastic guesswork.

It seeks to show how the past geological changes *may* have occurred; it never attempts to prove how they *must* have occurred. And I may say, in passing, that it is largely for the purpose of avoiding the cumulative character of the evidence gathered from

hundreds of stone quarries and from thousands of sections of strata in every corner of the globe, that the uniformitarians have wished to have these burials take place on the installment plan; for otherwise the violent and catastrophic character of the events recorded in the rocks would become too plainly manifest. But — begging the reader's pardon for repeating here an illustration already used in a previous chapter — if a coroner, called upon to hold an inquest, were to content himself, after the manner of Lyell and Hutton, with glittering generalities about how people are all the time dying of old age, fever, or other causes, coupled with assurances of the quiet, regular habits and good reputation of all his fellow citizens, I do not think that he would be praised for his adherence to inductive methods if we could get at clear and decisive evidence that the poor fellow under examination had been shot. Just so with common-sense methods in geology. *A true induction is capable of finding out for certain* whether or not the present quiet, regular action of the elements has always prevailed in the past; and it is most unscientific to continue to assert, as the followers of Hutton and Lyell have done, that the comparatively insignificant changes within historic time have always prevailed in the past, when there is now plenty of clear and decisive evidence to the contrary.

Prof. Alleyne Nicholson, it is true, thinks that the geological phenomena are only "a question of energy *versus* time." "We may," he says, "on the one hand suppose them to be the result of some very powerful

cause, acting through a short period of time. Or we may suppose them to be caused by a much weaker force acting through a proportionately prolonged period."

This might be so if we had only to consider *mere quantity* of deposition or erosion. But when we consider the *quality* or kind of work, the case is very different. A Hercules, by ages of toil, might pile up stone and brick to the region of the clouds; but no mere quantity of his clumsy work could create the Pyramid of Cheops or the Hall of Karnak. An eternity of hacking at stones with a hammer might be supposed capable of leveling the Alps or the Himalayas; but it could never produce a Venus de Milo or a Parthenon. And it seems to me that we must shut our eyes to very much of the geological evidence if we are still to maintain that untold ages of quiet deposition like that within our historic experience would ever produce the quality of work which is opened up to our wondering eyes in almost every quarter of the globe.

II

The general fact which I wish to develop in this chapter may be stated as follows:

Rocks belonging to all the various systems or formations give us fossils in such a state of preservation, and heaped together in such astonishing numbers, that we can not resist the conviction that the majority of these deposits were formed in some sudden and not modern manner, catastrophic in nature.

III

But before giving any examples of these abnormal deposits, we must first study the modern normal deposits; before we can rightly understand the sharp contrast between the ancient and the modern action of the elements, we must become familiar with the way in which fossils are now being buried by our rivers and oceans.

One of the many geological myths dissipated by the work of the "Challenger" expedition, which, as Zittel says, "marks the grandest scientific event of the nineteenth century," is that about the ocean bottom and the work now carried on there. The older textbooks taught not only that the bottom of the ocean is thickly strewn with the remains of the animals that died there and in the waters above, but also that the oceanic currents are constantly wearing away in some places and building up in others over all the ocean floor, and hence producing true stratified deposits. Accordingly, we were told that it was only necessary for these beds to be lifted above the surface to produce the ordinary rocks that we find everywhere about us. This was the very essence of the doctrine on which the science was built up. But we now know that the ocean currents have, as Dana says, "*no sensible, mechanical effects, either in the way of transportation or abrasion.*"[1] We know also that every kind of sediment drops so much quicker in salt water than in fresh, that none of it gets beyond the narrow "continental shelf" and the classic one-

[1] "Manual," p. 229.

hundred-fathom line, which, in most cases, is not very far from shore. In the North Atlantic, there are sediments found in deeper water, produced by ice floes or icebergs dropping their loads there; but we can not suppose such work to have gone on when the arctic regions were clothed with a temperate-climate vegetation, much less that such things occurred over all the earth. On the floor of the open ocean, and away from the tracks of our modern icebergs, we have four or five kinds of mud or ooze formed from minute particles of organic matter; but besides these, absolutely nothing save a possible sprinkling of volcanic products, which, of course, are limited in their distribution. Where, then, can we find a stratified or bedded structure now being formed over the ocean bottom? Sir John Murray, in his "Report on Deep-Sea Deposits," has shown in "a most thorough and convincing manner," to quote the strong words of Professor Suess, that there is nothing of the kind now being produced there. There is *no gravel, no sand, no ordinary clay;* but whatever variation we may imagine to take place in the organic deposits could never produce a real stratified or bedded structure.

The so-called Red Clay deposits of the deep ocean cover about 36 per cent of the oceanic area, or about 50,000,000 square miles, the Globigerina ooze making up over 29 per cent, or 40,000,000 square miles. Both of these deposits, covering as they do the greater part of the whole ocean bottom, are so entirely different from anything found in the fossiliferous

rocks that most geologists admit the total dissimilarity. True, the species of the Globigerina and other oozes are like those found fossil in the Cretaceous rocks, but the mechanical structure of the two is entirely different; while in the case of the Red Clay, which can hardly be said to contain animal remains, there is nothing like it through the whole range of the fossiliferous rocks, from the Cambrian to the Pleistocene.

It used to be thought that the chalk deposits were of deep-sea origin, because they are so largely composed of foraminiferal shells, similar to those found now at the bottom of the Atlantic and other oceans, in what are called the Globigerina oozes. But the chalk beds of England and Wyoming are often associated with sandstones or sandy shales, while in central Kansas the real chalk remains are rather scanty and are mixed up with fine yellow muds, which give a characteristic appearance to the beds. In western Alabama also there are some chalk beds about one thousand feet thick, and these beds change laterally into marls, clays, and sands, these latter distinctly terrigenous deposits being thus the mere continuation of beds which, in the chalk itself, are composed of organic remains like those of the deep-ocean oozes of modern times. Thus while the organic remains of these beds are similar to organisms now found only in any quantity in the deepest parts of the ocean, the mechanical texture of these beds, as well as their lateral extensions, are such as are now not being formed anywhere over any part of the floor of

the ocean. In other words, *this combination of deep-sea and terrigenous deposits is wholly abnormal,* and different from anything now forming in any part of the world.

It may be worth while to give here the words of some high authorities regarding the present condition of the ocean bottom, and the radical difference between these modern deep-sea deposits and those found composing the fossiliferous rocks. I quote first from Sir Archibald Geikie:

"Thanks to the great work done by the 'Challenger' and other national expeditions, we have learnt what are the leading characters of the accumulations now forming on the deeper parts of the ocean floor. So far as we know, they have no analogues among the formations of the earth's crust. They differ, indeed, . . . entirely from any formation which geologists have considered to be of deep-sea origin."[2]

Charles Schuchert says substantially the same thing:

"In the abysses there is not a trace of Paleozoic life, though from twenty-five to thirty genera, with a large number of species, are known in the present shallow seas. . . . Geologists have long sought on the continents for geologic sediments comparable to those now forming in the great abysses of the ocean, but to no avail. The German geologist, Walther, who has carefully examined recent abyssal sediments, in his geologic studies has considered repeatedly whether any fossil rock possesses abyssal characteristics, and nowhere has he met with strata, either of Paleozoic or Mesozoic age, that by their structure and nature of deposition corresponded to the present sediments of the oceans. Sir John Murray also failed to find oceanic rocks."[3]

[2] "Textbook," ed. 1903, p. 929.
[3] Pirsson and Schuchert, "Textbook," p. 481.

All this has been crystallized into the geological doctrine of the "permanency of the oceans," meaning that the present oceans have always existed since the beginning of the geological processes, and that they have never had their bottoms raised to make parts of the continents.

IV

Thus to explain practically all the deposits found in the rocks, we are absolutely limited to the shore deposits and the mouths of large rivers. Here we certainly have alternations of sand, clay, and gravel, producing a true bedded structure. But I ask, What kind of organic remains shall we get from these modern deposits? — Certainly nothing like the crowded graveyards that we find everywhere in the ancient ones.

Darwin, in his famous chapter on "The Imperfection of the Geological Record," has well shown how scanty and imperfect are the modern fossiliferous deposits. The progress of research has only confirmed and accentuated the argument there presented on this point. Thus Nordenskiöld, the veteran arctic explorer, remarks with amazement on the scarcity of recent organic remains in the arctic regions, where such a profusion of animal life exists; and he concludes with the following language:

> "It is strange, in any case, that on Spitzbergen it is easier to find the vertebræ of a gigantic lizard of the Trias than the bones of a self-dead seal, walrus, or bird; and the same also holds good of more southerly inhabited lands."

It is also an expressive fact in this connection that, in spite of the great numbers of cats, dogs, and

other domestic animals that are constantly being thrown into rivers like the Hudson or the Thames, dredgings about the mouths of these streams have revealed the surprising fact that scarcely a trace of any such animals is there to be found.[4]

Even the fishes themselves stand a very poor chance of being buried intact. As Dana puts it:

> "Vertebrate animals, as fishes, reptiles, etc., which fall to pieces when the animal portion is removed, *require speedy burial after death,* to escape destruction from this source [decomposition and chemical solution from air, rain water, etc.], as well as from animals that would prey upon them."[5]

If a vertebrate fish should die a natural death — which, of itself, must be a rare occurrence — the carcass would soon be devoured whole or bit by bit by other creatures near. Possibly the lower jaw, or the teeth, the spines, etc., in the case of sharks, or a bone or two of the skeleton, might be buried unbroken, but a whole vertebrate fish entombed in a modern deposit is surely a unique occurrence.

But every geologist knows that the remains of fishes are, in countless millions of cases, found in a marvelous state of preservation. They have been *entombed in whole shoals,* with the beds containing them miles in extent, and scattered over all the globe. Indeed, so accustomed have we grown to this state of affairs in the rocks we hammer up, that if we fail to find such well-preserved remains of vertebrate fishes, land animals, or plants, we feel disappointed, almost hurt; we think that nature has somehow slighted

[4] *Popular Science Monthly,* Vol. 21, pp. 143, 693.
[5] "Manual," p. 141.

this particular set of beds. But where, in our modern quiet earth, shall we go to find fish-deposits now forming like the copper-slate of the Mansfield district, the Jurassic shales of Solenhofen, the calcareous marls of Œningen on Lake Constance, the black slates of Glarus, or the shales of Monte Bolca? — to mention some cases from the continent of Europe more than

FIG. 66. View of the quarries at Lompoc, California. Accompanying the diatom rocks, here shown, are vast quantities of fish which were evidently entombed alive when this diatom deposit was laid down here.

usually famous in the literature for exquisitely preserved fishes, to say nothing of other fossils. Or we might mention the black Onondaga limestones of Ohio and Michigan; the Green River beds, Arizona; or the diatom beds of Lompoc, California, as a few examples from America of strata packed full of splendidly preserved fishes.

Buckland, in speaking of the fossil fish of Monte Bolca, which may be taken as typical of all the others,

is quite positive that these fish must have "perished suddenly," by some tremendous catastrophe.

"The skeletons of these fish," he says, "lie parallel to the laminæ of the strata of the calcareous slate; they are always entire, and so closely packed on one another that many individuals are often contained in a single block. . . . *All these fish must have died suddenly* on this fatal spot, and have been speedily buried in the calcareous sediment then in course of deposition. From the fact that certain individuals have even preserved traces of color upon their skin, we are certain that they were entombed before decomposition of their soft parts had taken place."[a]

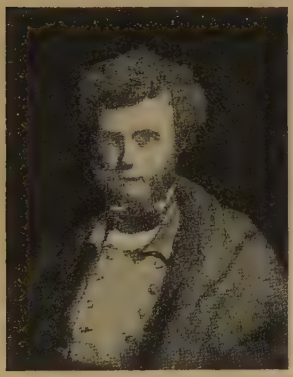


FIG. 67. Hugh Miller (1802-1856). Scotch geologist; author of "The Old Red Sandstone."

In many places in America as well as in Europe, where these remains of fish are found, the shaley rock is so full of fish oil that it will burn almost like coal, while some scientists have even thought that the peculiar deposits like Albertite "coal" and some cannel coals were formed from the distillation of the fish oil from the supersaturated rocks.

De la Beche was also of the opinion that most of the fossils were buried suddenly and in an abnormal manner. "A very large proportion of them," he says, "must have been *entombed uninjured, and many*

[a] "Geology and Mineralogy," ed. 1858, Vol. 1, pp. 124, 125.

alive, or, if not alive, at least before decomposition ensued."[1] In this, he is speaking not of the fishes alone, but of the fossiliferous deposits in general.

There is found in all parts of the world a series of strata which used to be called the "Old Red Sandstone," now known as the Devonian. In this, almost wherever we find it, the remains of whole shoals of fishes occur in such profusion and preservation that the "period" is often known as the "Age of Fishes." Dr. David Page, after enumerating nearly a dozen genera, says:

> "These fishes seem to have thronged the waters of the period, and their remains are often found in masses, as if they had been suddenly entombed in living shoals by the sediment which now contains them."

I beg leave to quote somewhat at length the picturesque language of Hugh Miller regarding these rocks as found in Scotland:

> "The river bullhead, when attacked by an enemy, or immediately as it feels the hook in its jaws, erects its two spines at nearly right angles with the plates of the head, as if to render itself as difficult of being swallowed as possible. The attitude is one of danger and alarm; and it is a curious fact, to which I shall afterward have occasion to advert, that *in this attitude nine tenths of the Pterichthes of the Lower Old Red Sandstone are to be found.* . . . It presents us, too, with a wonderful record of violent death falling at once, not on a few individuals, but on whole tribes. . . .
>
> "At this period of our history, some terrible catastrophe involved in sudden destruction the fish of an area at least a hundred miles from boundary to boundary, perhaps much more. The same platform in Orkney as at Cromarty is strewed thick with remains, which exhibit unequivocally the

[1] "Theoretical Geology," p. 265, London, 1834.

marks of violent death. The figures are contorted, contracted, curved, the tail in many instances is bent round to the head; the spines stick out; the fins are spread to the full, as in fish that die in convulsions. . . . The record is one of destruction at once widely spread and total, so far as it extended. . . . By what quiet but potent agency of destruction were the innumerable existences of *an area perhaps ten thousand square miles in extent annihilated at once,* and yet the medium in which they had lived left undisturbed in its operations?

"Conjecture lacks footing in grappling with the enigma, and expatiates in uncertainty over all the known phenomena of death."[8]

I will not taunt the uniformitarians by asking them to direct us to some modern analogies. But I would have the reader remember that these Devonian and other rocks are world-wide in extent.

Surely Howorth is talking good science when he says that his masters, Sedgwick and Murchison, taught him "that no plainer witness is to be found of any physical fact than that nature has at times worked with enormous energy and rapidity," and "that the rocky strata teem with evidence of violent and sudden dislocations on a great scale."

That the fishes in general were destroyed in some sudden and strange way, is further attested by a book published in 1923, entitled "Fishes the Source of Petroleum." It was written by J. M. MacFarlane, of the University of Pennsylvania, and is published by The Macmillan Company. I think that no one who will carefully read this work of more than four hundred pages can fail to agree that Professor MacFarlane has made out a strong case for believing

[8] "Old Red Sandstone," pp. 48, 221, 222.

that vertebrate fishes, destroyed in prodigious numbers, constitute the chief source, perhaps almost the only source, of our oil deposits.

This is one of the conclusions reached in this work:

"In review of the evidence presented in preceding chapters, the author is compelled to accept that fishes are the source

FIG. 68. A cliff of Cretaceous limestone, near Thatcher, Colorado. The layers containing marine shells are here seen alternating regularly and repeatedly with other layers derived from the land. (Gilbert, U. S. G. S.)

of practically the entire supply of crude petroleum, also of natural petroleum derivatives, like the asphaltites. For fishes alone meet the requirements of the case."[9]

He says that in these studies he has been "increasingly impressed by the apparent recurring cataclysmic

[9] Page 384.

crustal wave'' which may have figured largely in the destruction of these myriads. And he proceeds thus:

"Consideration of the above leads one to observe as to the evident periodic and cataclysmic obliteration of whole genera and tribes of fishes. While uniformitarian causes doubtless effected slow extinction of many of these groups, the writer is compelled to claim a more or less cataclysmic action for the majority."[10]

This rhythmic or recurrent action in the deposition of the rock sediments, spoken of above, is one of the most common and most noticeable phenomena which we encounter in the study of the rocks all over the world. It suggests a recurrent tidal action of an abnormal character, as I have pointed out elsewhere, as the cause of these geological deposits.

As for the extent of some of these deposits, he shows that "the Oligo-Miocene oil strata which are named the 'amphisyle' and 'meletta' shales can be traced almost continuously for about 2,500 miles"; while "the fishes, mollusks, polyzoa, and other organisms recorded from the Caucasian or the Galician centers show a marked similarity to those of Glarus or even of California."[11] And these facts suggest that the destruction may have been essentially simultaneous over all this area.

He further says:

"It can be definitely said that, through all the geologic formations in which fish remains occur, a large proportion of the remains consists of entire fishes or of sections in which every scale is in position; every fin is extended as in life atti-

[10] Pages 388, 389.
[11] Page 398.

tude; the bones of the head, though often crushed in and broken through subsequent diastrophic strains, still retain almost the normal positions; while near them may be coprolites of the same or some other types of fish in a practically entire state. All of this conclusively proves that when myriads of such fish were simultaneously killed, their bodies were deposited or stranded within a few hours or a few days at most after death, so that the flesh, the liver, the alimentary canal, and other soft parts were unquestionably inclosed and intact, when sediment sealed them up. Numerous experiments that the writer has undertaken, prove that even after from five to six days dead fishes begin to lose scales, to be attacked and nibbled at by other fishes, by crabs, and by smaller fry, while as yet the flesh and entrails are inclosed, though softened. We unhesitatingly conclude, then, that a large proportion of the fishes met with in 'fish beds' and oil strata were stretched out and preserved intact either immediately or within a day or two at most after death.''[12]

All this is in complete accord with many statements which might be quoted from the writings of the founders of the science, written before the uniformitarian dogma of Lyellism had made such truthful descriptions unfashionable.

V

I have spoken somewhat at length of the class, fishes; but what other class of the animal kingdom will not point us a similar lesson? The reptiles and the amphibians, to say nothing of the larger mammals, are also found in countless myriads, packed together as if in natural graveyards. Everybody knows of the enormous numbers and splendid preservation of the great reptiles of the Western and Southern States, untombed by Leidy, Cope, and

[12] Page 400.

Marsh. One patch of Cretaceous strata in England, the Wealden, has afforded over thirty different species of dinosaurs, crocodiles, and plesiosaurs. Mr. Charles H. Sternberg reported great quantities of amphibians from the Permian of Texas. They are of all sizes, some frogs being six feet long, others ten. Besides these, he found "three bone-beds full" of minute forms an inch or less in length. Of the small ones, which I judge must represent whole millions of young ones suddenly entombed, he says:

> "I got over twenty perfect skulls, many with vertebræ attached, and thousands of small bones from all parts of the skeleton. In one case, a complete skull, one fourth of an inch in length, had connected with it nearly the entire vertebral column, with ribs in position, coiled upon itself, bedded with many bones of other species in a red siliceous matrix. So perfectly were they weathered out that they lay in bas-relief as white and perfect as if they had died a month ago; a single row of teeth, like the points of cambric needles, occupied both sets of jaws."[13]

How many more such cases there may have been in these "three bone-beds full" of similar remains, it would be interesting to know. From this picturesque description, one can understand that the physical evidence here is not only conclusive as to the sudden entombment of these animals, but also clearly proves that these specimens are not any more ancient in reality than any of the Pleistocene deposits.

But the invertebrates are also eloquent to the fact that abnormal conditions must have prevailed when their remains were entombed. We might go through

[13] *Popular Science News*, May, 1902, pp. 106, 107.

the whole list, but we would find it to be the same old story of abnormal deposits, essentially different from anything that is being made to-day.

Where, for instance, in the modern seas, shall we find corals now being intercalated between beds of clays or sands over vast areas, as we find them in the Lias and Oölite of England and elsewhere? Corals require a definite depth of water, neither too deep nor too shallow, but it must be clear and pure; and nothing but some awful catastrophe could place a bed of coral remains a few feet or a few inches in thickness over the vast areas where we find them. Crinoids require the same clear, pure water, but much deeper, some of the modern kinds living more than a mile down, where there is no sand, no clay, absolutely nothing to disturb the eternal calm. But every student of the science knows that the Subcarboniferous limestone of both Europe and America (called Mountain Limestone in England), so noted for its crinoids and its corals, is constantly found intercalated between shale or sandstone, or between the coal beds themselves, as at Springfield, Illinois, in the Lower Coal Measures of Westmoreland County, Pennsylvania, or in the Petoskey and Traverse Bay regions of Michigan."[14]

What are we to say about the great sheets of foraminiferal limestone so constantly associated with the coal deposits of southern Russia, China, Japan, Borneo, Sumatra, to say nothing of the Alps and of the western part of the United States, extending as far east as Illinois?

[14] "Principles of Stratigraphy," Grabau, p. 429.

The following is the testimony of Lyell:

"There are also several regions in Scotland, and in the central and northern parts of England, where the marine Mountain Limestone alternates with strata containing coal in such a manner as to imply the drifting down of plants by rivers into the sea, and the alternate occupation of the same space by fresh and salt water."[15]

There may be here and there some considerable masses of these rocks which represent an original formation by growth *in situ;* but no one can say this for the majority of the limestones, which are usually just as truly stratified formations, laid down by flowing water, as any sandstone or shale. In many of the Coal Measures, one can count from a dozen to two dozen beds of limestone (formed from marine animals) intercalated between the sandstones and shales, or even directly between the coal beds themselves.

FIG. 69. *Rhynchonella Boueti.* (Cornbrash.) *d,* Deltidium; *f,* foramen.

Next, let us consider the pelecypods, such as the oyster, the clam, and the other true bivalves. These creatures have an arrangement in the hinge region by which the valves of the shell tend to open, but during life are held together by the adductor muscles. When dead, however, these muscles relax and decay, and then the valves spread open. Forms that burrow deeply, as *Solen, Lutraria, Mya,* etc., often gape widely; and even if they died a natural death in their holes, some mud must inevitably wash into their burrows, filling their empty shells. But many kinds

[15] "Principles," pp, 114, 115.

of bivalves do not thus burrow in the ground; and when the fossils of such kinds are found in quantity with the valves applied and often hollow, as is so frequently the case in many of the "older" rocks, I can not see how we are to understand any ordinary conditions of deposit.

Or let us take the brachiopods. These have a bivalve shell, the parts of which, however, are not

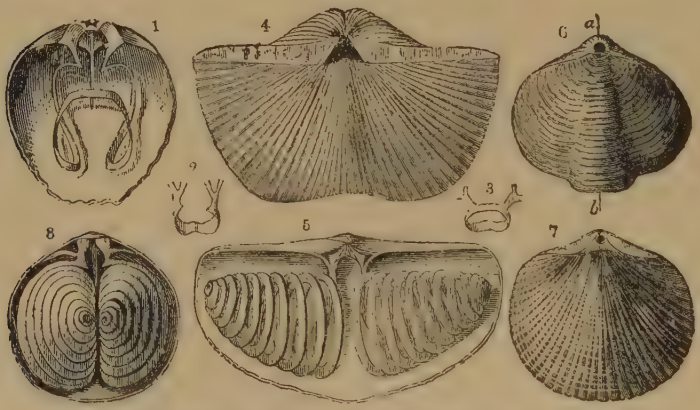


FIG. 70. Brachiopods, showing external and internal features. Note 4 and 6, which are *Spirifer* and *Athyris*, mentioned in the text. (After Dana.)

pulled apart after death, and only need to open a little way, even in life, to admit the sea water that brings them their food. Yet, though the valves do not gape after death, there is a hole at the hinge or beak (see Figs. 69, 70), when they are dead and empty, which would readily admit mud if such were present in the water, or if the shells after death were subject to the ordinary movements of tide, wave,

and current. Yet Dawson says of the brachiopods *Spirifer* and *Athyris:*

"I may mention here that in all the Carboniferous limestones of Nova Scotia the shells of this family are usually found with the valves closed and the interior often hollow."[16]

He tries to explain how this state of things might occur "in deep and clear water"—for most of the modern species are found in the clear depths many thousand feet down—and he thinks that their entombment in this condition "does not prove that the death of the animals was sudden." This was written in the old days when people knew nothing of conditions on the ocean bottom. But we now know that there is no means of producing a stratified formation in this "deep and clear water," and hence that some revolution of nature is implied by the conditions in which we find them.

Some people seem to have converted David Hume's famous sentence into a scientific formula, thus: "Anything contrary to uniformity is impossible; hence no amount of evidence can prove anything contrary to uniformity."

For the trouble in this case is that not only do such conditions prevail "in all the Carboniferous limestones of Nova Scotia," which must be several thousands of square miles in extent, but in the Devonian shales and Silurian limestones throughout North America at least—doubtless over the rest of the world—the brachiopods are found in this same tell-

[16] "Acadian Geology," p. 260.

tale condition, and it would establish a very dangerous precedent to admit abnormal conditions in even a single case.

VI

I have only touched upon the voluminous evidence that might be adduced in the case of the lower forms of life. Had I the space, I might show how the marvelously preserved plants of the coal beds tell the same story. But we must pass on to consider the remains of the larger land animals. I have already given a quotation from Dana about the mammoth and rhinoceros in northern Siberia, where he says that their incasing in ice and the perfect preservation of their flesh "shows that the cold finally became *suddenly* extreme, as of a single winter's night, and knew no relenting afterwards." Not very many serious attempts have been made to account for this remarkable state of things, which is a protest against uniformity that can be appreciated by a child; and I

FIG. 71. Elephant tusk found during mining operations on the ground of the Tolstoi Mining Company, at Boob Creek, Alaska. (Harrington, U. S. G. S.)

never heard of any theory which attempted to account for the facts without some kind of awful catastrophe.

Many, however, seem to have little idea of the extent of these remains in the arctic regions. They are not all thus perfectly preserved; for thousands of skeletons are found in localities where the ground partially thaws out in the short summer, and therefore the skin and the tissues could not remain intact. Remains of these beasts occur in only a little less abundance over all western Europe, and the mammoth also in North America, well-preserved specimens having been obtained from the Klondike region of Canada; and there is nothing to forbid the idea that many if not most of these latter specimens were also at one time enshrined as "mummies" in the ice and frozen soil which has since thawed out over the more temperate regions. But we must confine ourselves to the remains in Siberia. Flower and Lydekker tell us that since the tenth century at least, these remains have been quarried for the sake of the ivory tusks, and a regular trade in this fossil ivory, in a state fit for commercial purposes, has been carried on "both eastward to China, and westward to Europe," and that "fossil ivory has its price current as well as wheat."

"They are found at all suitable places along the whole line of the shore between the mouth of the Obi and Bering Straits, and the further north the more numerous do they become, the islands of New Siberia being now one of the favorite collecting localities. The soil of Bear Island and of Liachoff Islands is said to consist only of sand and ice with such quantities of mammoth bones as almost to compose its chief substance. The remains are not only found around the mouths of the

great rivers, as would be the case if the carcasses had been washed down from more southern localities in the interior of the continent, but are imbedded in the frozen soil in such circumstances as to indicate that the animals had lived not far from the localities in which they are now found, and they are exposed either by the melting of the ice in unusually warm summers, or by the washing away of the sea cliffs or river banks by storms or floods. In this way the bodies of more or less nearly perfect animals, even standing in the erect position, with the soft parts and hairy covering entire, have been brought to light."[17]

These remains of the mammoth, though the best known, are not the only ones attesting extraordinary conditions; but of course in warmer latitudes, we do not find perfect "mummies," with the hide and the flesh preserved untainted. Let us go to a warmer climate, to Sicily, and read a description of the remains of the hippopotamus found there. I quote from Sir Joseph Prestwich:

"The chief localities, which center on the hills around Palermo, arrest attention from the extraordinary quantity of bones of hippopotami (in complete hecatombs) which have there been found. Twenty tons of these bones were shipped from around the one cave of San Circo, near Palermo, within the first six months of exploiting them, and they were so fresh that they were sent to Marseilles to furnish animal charcoal for use in the sugar factories. How could this bone breccia have been accumulated? . . . The only suggestion that has been made is that the bones are those of successive generations of hippopotami which went there to die. But this is not the habit of the animal, and besides, the bones are those of animals *of all ages down to the fetus,* nor do they show traces of weathering or exposure. . . .

"My supposition is, therefore, that when the island was submerged, the animals in the plain of Palermo naturally

[17] "Mammals," p. 430.

retreated, as the waters advanced, deeper into the amphitheater of hills until they found themselves embayed, as in a seine, with promontories running out to sea on either side and a mural precipice in front. As the area became more and more circumscribed the animals must have thronged together in vast multitudes, crushing into the more accessible caves, and swarming over the ground at their entrance, until overtaken by the waters and destroyed."[18]

Prestwich adds that the extremely fresh condition of the bones proves that "the event was geologically comparatively recent," while "the fact that animals of all ages were involved in the catastrophe" tends to prove that it was "sudden."

That it must have been a good deal more "sudden" than even this author will admit, is evident from the nature of the hippopotamus. I never thought that the animal was particularly afraid of water, or likely to be drowned by any such moderate catastrophe as Prestwich invokes in this very singular volume. The reader must, however, note that this affair, like the entombment of the mammoth, certainly took place since man was upon the globe, even according to the uniformitarians. Would it not be economy of energy to correlate the two catastrophes? But if man dates from "Miocene times," as some contend, he must have witnessed half a dozen awful affairs like these, according to the common view; for there is scarcely a country on the globe which has not been under the ocean since then. One great world-catastrophe is sufficient to account for all these facts.

[18] "On Certain Phenomena," etc., pp. 50-52.

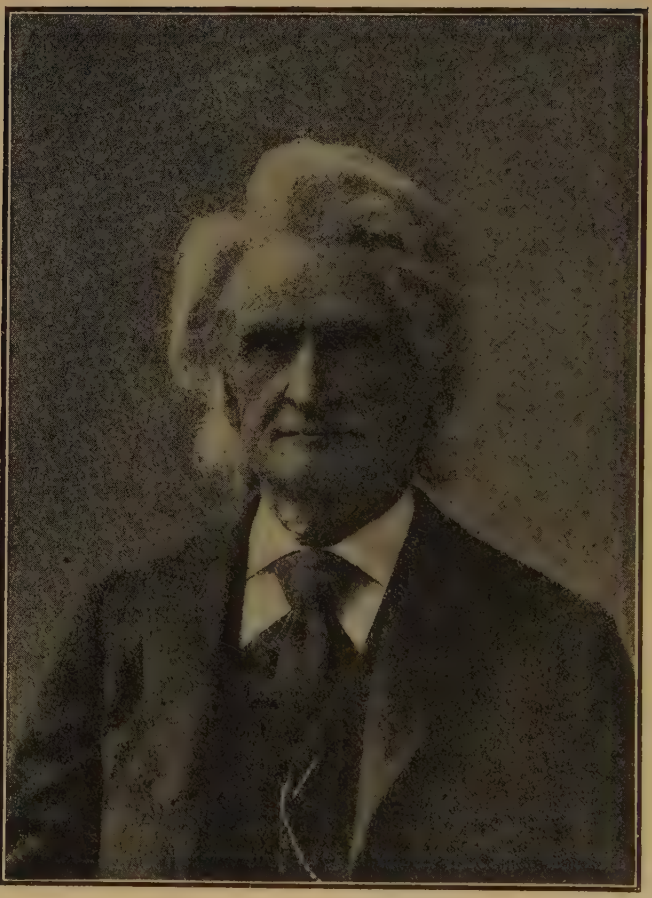


FIG. 72. James D. Dana (1813-1895).

VII

Let us proceed.

But whither shall we turn to avoid finding similar phenomena? The vast deposits of mammals in the

Rocky Mountains may occur to the reader. As Dana says, those mountains "have been found to be literally Tertiary burial grounds." I need not go into the details of these deposits, nor of those in other places containing the great mammals that must have been contemporary with "Tertiary man"; for I should only weary the reader with a monotony of abnormal conditions of deposits — unlike anything now being produced this wide world over. We shall be stating the case very mildly indeed if we conclude that the vast majority of the fossils, by their profuse abundance and their astonishing preservation, tell a very plain story of "speedy burial after death," and *are of an essentially different character from modern deposits.*

Professor Nicholson, in speaking of the remains of the Zeuglodon, says:

"Remains of these gigantic whales are very common in the 'Jackson beds' of the southern United States. So common are they that, according to Dana, 'the large vertebræ, some of them a foot and a half long and a foot in diameter, were formerly so abundant over the country in Alabama that they were used for making walls, or were burned to rid the fields of them.'"[19]

Shortly before his death, in 1895, Dana prepared a revised edition of his "Manual," and in it he gives us a quite rational explanation of this case, as follows:

"Vertebræ were so abundant, on the first discovery, in some places that many of these Eocene whales must have been

[19] "Ancient Life-History," p. 300.

stranded together in a common catastrophe, on the northern borders of the Mexican Gulf — possibly by a series of earthquake waves of great violence; or by an elevation along the sea limit that made a confined basin of the border region, which the hot sun rendered destructive alike to Zeuglodons and their game; or by an unusual retreat of the tide, which left them dry and floundering under a tropical sun.''[20]

That is, this veteran geologist, in his old age, would not attempt to account for such abnormal

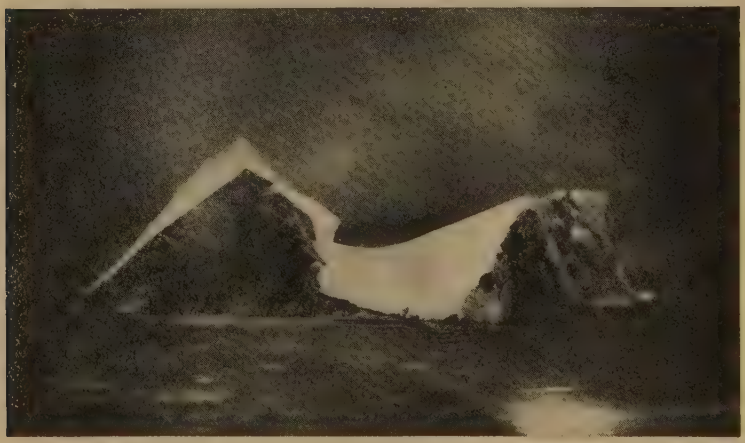


FIG. 73. Iceberg seen near the head of Trinity Bay, Newfoundland. Only a small portion of the iceberg is visible above the water. It is worthy of note that some recent investigations in the Antarctic have convinced certain men that sea-ice is more important than previously supposed in producing geological deposits; and that land-ice (glaciers), on the other hand, protects the land instead of wearing it away. (Walcott, U. S. G. S.)

conditions without a catastrophe of some kind. But if we use similar explanations for similar conditions, where shall we stop through the whole range of the rocks from the Cambrian to the Pleistocene?

[20] Page 908.

VIII

Dana became very fond of this idea of earthquake waves, and invoked them to account for "the universality and abruptness" with which the species disappear at the close of "Paleozoic time," using as the generating cause the uplifting of the Appalachian Mountains, with "flexures miles in height and space, and slips along newly opened fractures that kept up their interrupted progress through thousands of feet of displacement," from which he says "incalculable violence and great surgings of the ocean should have occurred and been often repeated. . . . Under such circumstances the devastation of the sea border and the low-lying lands of the period, the destruction of their animals and plants, would have been a sure result. The survivors within a long distance of the coast line would have been few."[21]

But as this sudden break in the life-chain "was so general and extensive that no Carboniferous species is known to occur among the fossils of succeeding beds, not only in America and Europe, but also over the rest of the world,"[22] he is obliged to make his catastrophe by earthquake waves *positively world-wide*. Hence he adds, "The same waves would have swept over European land and seas, and there found coadjutors for new strife in earthquake waves of European origin."

At the close of the Mesozoic, he uses similar language, though in this case he has the whole range of

[21] "Manual," p. 736.
[22] Page 735.

the mountains on the west of both North and South America, the Rockies and the Andes, in length a "third of the circumference of the globe," "undergoing simultaneous orogenic movements, with like grand results."[23] "The deluging waves sent careering over the land" would, he thinks, "have been destructive over all the coasts of a hemisphere," and "may have made their marches inland for hundreds of miles,"[24] sweeping all before them.

I should think so; but then *what becomes of this fetish of uniformity?* Personally, I have not the slightest objection to these "deluging waves sent careering over the land," for I feel sure that just such things have occurred, and on just such a scale as our author pictures; for, as he says, the destruction of species "was great, world-wide, and one of the most marvelous events in geological history."[25] [26]

But it seems to me that here we have an enormous amount of energy going to waste. Others have demanded a continent to explain the appearance of a beetle in a certain locality; but here we have a great world-wide catastrophe to explain the sudden disap-

[23] "Manual," page 875.
[24] Page 878.
[25] Page 877.
[26] Prof. Eduard Suess, with his usual transparent candor, when referring to the work of Sir John Murray in proving that the deposits now gathering at the bottom of our modern oceans contain no gravel, or sand, or clay, or any "admixture of mineral matter derived from the surface of the land," points out how sharply they contrast with the old-time geological deposits. And in speaking of the manner in which some at least of the geological changes must have occurred, he says that many of them must have been "of such indescribable and overpowering violence that the imagination refuses to follow the understanding and to complete the picture" of how they were really accomplished. ("The Face of the Earth," Vol. 1, pp. 4, 17, 18.)

pearance of merely a few species. Why not utilize this surplus energy in doing other work that has certainly been accomplished somehow, but has hitherto gone a-begging for a competent cause? The only thing I object to in Dana's view of the case is his way of having these "exterminations" take place on the installment plan. For, in that way, we have to work up a great world-catastrophe to do only a very limited amount of work, and then have to repeat the thing another time for a similarly limited work, *when one such cosmic convulsion is competent to do the whole thing.* I plead for the "law of parsimony," and the economizing of energy.

As Sir Isaac Newton expressed it in his "*Regulæ Philosophandi,*" "No more causes are to be admitted than such as suffice to explain the phenomena"; and also, "In so far as possible, the same causes are to be assigned for the same kind of natural effects."

It will never do to disregard continually these simple axioms of inductive reasoning, if we expect our geology to rank with the other sciences founded on the principles of induction.

The vast shoals of carcasses which seem to be piled up in almost every corner of the world are *prima facie* evidence that our old globe has witnessed some sort of cosmic convulsion. The exact cause, nature, and extent of this event, we may never have sufficient facts to determine, though two or three additional facts having a bearing on the subject will be considered in the following chapters.

CHAPTER X

Change of Climate

I

Another great general fact about the fossil world may be stated somewhat as follows:

All the fossils (save a very few of the so-called "Glacial age," and they admit of other easy explanation) *give us proofs of an almost eternal spring's having prevailed in the arctic regions, and semitropical conditions in north temperate latitudes; in short, give us proofs of a singular uniformity of climate over the globe, which we can hardly conceive possible, let alone account for.*

The proofs of this are almost unnecessary, as this subject of climate has been pretty well discussed of late years. And it was the overwhelming evidence on this point which forced Lyell and so many others to decide against the theory of Croll, which called for a regular rotation of climates; for they said that the fossil evidence was wholly against such a view. Howorth has given an admirable argument on this point in chapter eleven of his second work on the Glacial theory,[1] and to it I would refer the reader for details that I have not the space to reproduce here.

This is not the place to discuss the Glacial theory as a whole; but I may be allowed to say, in passing,

[1] "The Glacial Nightmare and the Flood," pp. 426-479.

that I consider Howorth's argument to be sound, that continental ice sheets could never have done the kind of work attributed to them, but that great earthquake waves, or *"tsunamis,"* to give the Japanese term, perhaps carrying masses of floating ice, might have

FIG. 74. So-called "tillite," or glacier-formed deposits, in Permian strata, state of Sao Paulo, Brazil. On the Mogyara Railway, between the stations Coronel Correa and Baldeacao. As this is within the tropics, it is difficult to believe that this area was once covered with a vast ice sheet. Would it not be more reasonable to seek some other explanation of these beds? (From Bulletin of the Geological Society of America, Vol. 30, 1918, pl. 10. Dr. G. Florence, photograph.)

caused these phenomena. In this connection it is very significant that the most recent investigators of the glaciers in the antarctic now declare that "glaciers protect the underlying land," and that the ice mantle of the antarctic, considered as a whole, "exercises

a predominantly conservative influence.'"[2] These authors declare that "ice plus water is the effective agent" in producing the "glacial" phenomena; and they emphasize the "importance of sea ice as a geological agent."[3]

Howorth emphasizes the fact, too often ignored, that by far the best thermometer for testing the character of a climate is the flora and fauna that lived while it prevailed. In fact, this is the only reliable test we can apply when studying the climate of past ages. All other kinds of evidence whatever are always rendered ambiguous by the fact that we may

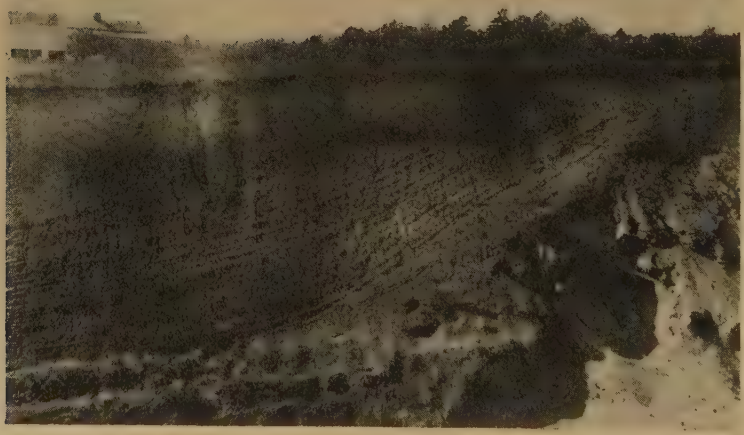


FIG. 75. Sandy base of clay (of marine origin) lying on top of "drift" or "till." In a railway cut, West Falmouth, Maine. (Katz, U. S. G. S.)

[2] *Nature*, March 22, 1924, p. 418.
[3] Ibid.

be attributing to climate what may be due to other causes entirely. Bowlders, says Howorth, can be rolled by the sea as well as by subglacial streams, and conglomerates may be formed by other agencies than ice.

But it is just such flimsy evidence as a few scratched stones or a few angular conglomerates, called, by courtesy, "tillites," which has led many eminent geologists into the mistake of speaking of ancient glaciers in the tropics near the sea level, in the Talchir conglomerates of India, and in the Karroo beds of South Africa. A reliance upon just the same kind of evidence led Agassiz and some of the first enthusiastic glacialists to say that the whole globe, tropics and all, was once covered with glaciers. In these modern instances reported from India and Africa, the absurdities are further increased by the physical evidence *in both instances* that the movement, whatever it was, proceeded *from the equatorial region toward the pole.*[4]

But a reliance on the evidence of the floras and faunas would save us from such absurdities. The biological evidence is unmistakable; "cold-blooded reptiles," as Howorth says, "can not live in icy water; semitropical plants, or plants whose habitat is in the temperate zone, can not ripen their seeds and sow themselves under arctic conditions." Nor could corals and other creatures now living in the warm waters of the tropics have lived in former times around the north pole if the climate had not been

[4] "Textbook," Grabau, ed. 1921, Part 2, pp. 520-523.

radically and entirely different from what it is at present.

But Howorth thus proceeds:

"We may examine the whole series of geological horizons, from the earliest Paleozoic beds down to the so-called Glacial beds, and find, so far as I know, no adequate evidence of discontinuous and alternating climates, no evidence whatever of the existence of periods of intense cold intervening between warm periods, but just the contrary. Not only so, but we

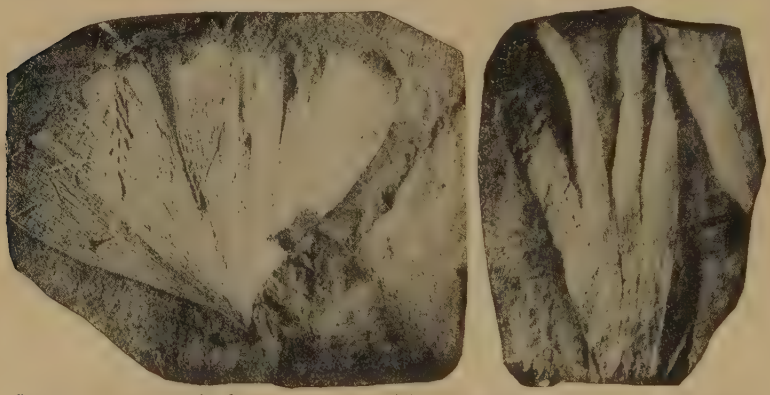


FIG. 76. Parts of palm leaves, from Cape Lisburne, Alaska. These are, of course, tropical or semitropical in habitat. (U. S. G. S.)

shall find that *the differentiation of the earth's climate into tropical and arctic zones is comparatively modern*, and that in past ages not only were the climates more uniform, but more evenly distributed over the whole world."

F. H. Knowlton, one of our foremost paleobotanists, says about the same thing:

"Relative uniformity, mildness, and comparative equability of climate, accompanied by high humidity, have prevailed over the greater part of the earth, extending to or into polar circles, during the greater part of geologic time — since

at least the middle Paleozoic. This is the regular, the ordinary, the normal condition."[5]

This author goes on to say that there was "a non-zonal arrangement" of climate "prior to the Pleistocene," and that the temperature of the oceans was everywhere the same and without "widespread effect on the distribution of life."[6]

David White argues for a mild, subtropical climate during the formation of the coal deposits; and Knowlton says that White's argument applies with equal force to all horizons.

I am aware that these statements of the botanists have been hotly contested by Schuchert, Coleman, and others; but it seems that the objective evidence of the fossil plants completely overwhelms the *a priori* inferences adduced from a few scratched stones and coarse conglomerates.

II

Without attempting to follow through the whole series of formations, we may note a few characteristic statements of the textbooks. Thus Dana says of the Cambrian:

"There was no frigid zone, and there may have been no excessively torrid zone."

While of the Silurian coral limestones of the arctic regions, he says:

"The formation of thick strata of limestone shows that life like that of the lower latitudes not only existed there, but flourished in profusion."[7]

[5] *Geological Society of America Bulletin*, 1919, Vol. 30, p. 501.
[6] Pages 541, 548.
[7] "Manual," pp. 484, 524, 525.

The Silurian corals, so widely distributed in the arctic regions, are the best of testimony that the ocean water of those regions must have been warm, very much like the waters of the tropics of to-day. Corals can not live in cold water; and these Silurian corals, which built extensive coral reefs in various parts of the arctic regions, must have required warm water for their existence, just as their relatives living to-day in the tropics require warm water.

But coral limestones of the Carboniferous system are the nearest known fossiliferous rocks to the north pole, and from the strike of the beds, must underlie the Polar Sea. In the words of Howorth, "coal strata with similar fossils have occurred all round the polar basin, . . . and may be said, therefore, to have occupied a continuous cap around the north pole."[8]

Again I quote from Howorth regarding the Mesozoic rocks:

"This very widespread fauna and flora proves that the high temperature of the Secondary era prevailed in all latitudes, and not only so, it pervaded them apparently continuously without a break. There is no evidence whatever, known to me, that can be derived from the fauna and flora of Secondary times, which points to any period of cold as even possible. There are no shrunken and stunted forms, and no types such as we associate with cold conditions, and no changes evidenced by intercalated beds showing vicissitudes of life."

The following is from Nordenskiöld, as quoted by Howorth, and refers to the whole geological series:

"From what has been already stated it appears that the animal and vegetable relics found in the polar regions, em-

[8] Pages 434, 435.

bedded in strata deposited in widely separated geological eras, *uniformly testify that a warm climate has in former times prevailed over the whole globe.* From paleontological science no support can be obtained for the assumption of a periodical alternation of warm and cold climates on the surface of the earth."[9]

And now we have the equally positive language of A. R. Wallace:

"It is quite impossible to ignore or evade the force of the testimony as to the continuous warm climate of the north temperate and polar zones throughout Tertiary times. The evidence extends over a vast area both in space and time, it is derived from the work of the most competent living geologists, and it is absolutely consistent in its general tendency. . . . Whether in Miocene, Upper or Lower Cretaceous, Jurassic, Triassic, Carboniferous, or Silurian times, and in all the numerous localities extending over more than half the polar regions, we find *one uniform climatic aspect of the fossils.*"[10]

III

Of course, in all this, I am taking the various kinds of fossils in the traditional chronological order. I do not know that I need to do this; for if anyone has attentively read the first part of this book, and still continues to believe that the current distinctions between "Eocene," "Miocene," "Pliocene," and "Pleistocene" are really scientific, or that they represent more than taxonomic classifications artificially arranged under a uniformitarian bias and the dominating prejudice of an approaching "Glacial Age," I do not suppose that any further arguments of mine will make any impression.

[9] "The Glacial Nightmare and the Flood," p. 45.
[10] "Island Life," pp. 182, 195, 196. "Nightmare," pp. 455, 456.

But I shall show presently that many good modern authorities claim that man existed in "Pliocene times," some even say in the "Miocene"; and in view of such an admission, we have, even from the standpoint of current theory, a vital, personal interest in this question of climate. Let us take, then, the following from James Geikie, the great champion of the Glacial theory, on the climate of the arctic regions at this part of *the human epoch:*

"Miocene deposits occur in Greenland, Iceland, Spitzbergen, and at other places within the arctic circle. The beds contain a similar [similar to the "most luxuriant vegetation" of Switzerland] assemblage of plant remains; the palm trees, however, being wanting. It is certainly wonderful that within so recent a period as the Miocene, a climate existed within the arctic regions so mild and genial as to nourish there beeches, oaks, planes, poplars, walnuts, limes, magnolias, hazel, holly, blackthorn, logwood, hawthorn, ivy, vines, and many evergreens, besides numerous conifers, among which was the *Sequoia,* allied to the gigantic *Wellingtonia* of California. This ancient vegetation has been traced up to within eleven degrees of the pole."[11]

According to Dana and other American geologists, the "Glacial period" is only a variation intervening between the warm Tertiary and the equally warm "Champlain period," and it was during the latter that the mammoth, mastodon, etc., roamed over Europe, Asia, and America. Of the climate then indicated, when all acknowledge that man was in existence, Dana says:

"The genial climate that followed the Glacial appears to have been marvelously genial to the species, *and alike for all*

[11] "Historical Geology," p. 76.

the continents, Australia included. The kinds that continued into modern time became dwindled in the change wherever found over the globe, notwithstanding the fact that genial climates are still to be found over large regions."[12]

In his "Geological Story Briefly Told," he uses even stronger language:

"The brute mammals reached their maximum in numbers and size during the warm Champlain period, and many species lived then which have since become extinct. Those of Europe and Britain were largely warm-climate species, such as are now confined to warm temperate and tropical regions; and only in a warm period like the Champlain could they have thrived and attained their gigantic size. The great abundance of their remains and their condition show that the climate and food were all the animals could have desired. They were masters of their wanderings, and had their choice of the best."[13]

"The genial climate of the Champlain period was *abruptly* [italics Dana's] terminated. For carcasses of the Siberian elephants were frozen so suddenly and so completely at the change, that the flesh has remained untainted."[14]

I quite agree with this author that the evidence is conclusive as to the climate and food being "all the animals could have desired," and that they must have "had their choice of the best." But it seems to me that in following out their theory, these authors have not left the poor creatures very much to choose from. For as the inevitable result of their theory in arranging the plants as well as the animals in chronological order according to the percentages of living and extinct forms, they have already disposed of, and consigned to the "early" Tertiaries, etc., all the probable vege-

[12] "Manual," p. 997.
[13] Edition of 1875, p. 225.
[14] Id., p. 230.

tation on which these animals lived, and thus *have nothing left on which to feed the rhinoceros, elephant, etc., away within the arctic circle, except a few miserable shrubs and lichens which now survive there.*

Many persons seem to think that the mammoth was some sort of freak elephant, peculiarly adapted to an arctic climate like a musk ox or a reindeer; and they think of the coat of hair found on the Siberian "mummies" as proof of this idea. This curious error on the part of the general public may readily be accounted for when we remember the vast amount of misinformation which has been published on this subject, some of it even by writers with some scientific reputation. But the mammoth was essentially identical with the modern Indian elephant, and its diet and its habits of life must have been like those of modern elephants. Modern elephants have fine hairs scattered all over their bodies; some of them have considerable.

Moreover, the skin of the mammoth has been subjected to careful microscopic study, and it has been found that its skin, like that of the modern elephants, had neither sweat glands nor sebaceous glands, a peculiarity which is found elsewhere only in a few of the mammals of the tropics. The author to whom I am indebted for these facts, M. H. Neuville, goes on to say:

"The very peculiar fur of the mammoth thus furnished only a precarious protection against cold, a protection analogous to that enjoyed at present by a few mammals of the tropical zone. Its dermis was, it is true, very thick, but no more so than that of the existing elephants. It appears to

me impossible to find in the anatomical examination of the skin and pelage, any argument in favor of adaptation to cold.''[15]

Hence we are absolutely safe in concluding that the climate of all the arctic regions must have been mild and warm when these vast herds of elephants and rhinoceroses roamed over their plains.

But the strange, inconsistent notion, held by Dana and many other geologists, that the so-called glacial phenomena lie *in between* the warm Tertiary and the equally warm ''Champlain period,'' is easily understood as the survival of the notion, so tenaciously held even later than the middle decades of the nineteenth century, that man was *not* a witness of any of the great geological changes. When the evidence became overwhelming that man lived while the semitropical animals roamed over England, the ''Glacial period'' still remained as a sort of mental buffer against the dangerous possibility of extending the human period back any further. I am not aware that this venerable scientist ever became quite reconciled to the idea of ''Tertiary Man,'' though in his ''Manual'' he mentions a few evidences in favor of this now almost universally accepted opinion.

As for the real teachings of the Drift phenomena there is no need of explanation here. At the very most, they are confined to a quite limited part of the Northern Hemisphere, there being no trace of them in Alaska, nor on the plains of Siberia, where now almost eternal frosts prevail.[16] In fact, they are prac-

[15] Annual Report of the Smithsonian Institution, 1919, p. 332.

[16] See Dana's ''Manual,'' pp. 945, 977; also ''The Glacial Nightmare,'' pp. 451, 452, 511, etc.

tically confined between the Rocky Mountains and the Missouri River on the west, and the Ural Mountains on the east; and with a little common sense infused into the foundation principles of the science, we shall cease to be tormented with a "glacial nightmare." Much of the Drift phenomena with the raised beaches are certainly *later* events than most of the other geological work, but are inseparably connected with the general problem in their explanation.[17] Even from the ordinary viewpoint, I am not aware that the elaborate argument of Howorth has ever been satisfactorily answered. Indeed, I feel almost like saying that this writer's various contributions to the cause of inductive geology mark the beginning of the dawn.

It may suffice here to call attention merely to the great simplicity introduced into this vast complexity of the Glacialists by the positive assurance of this author that the "Drift period" and the Pleistocene end together, and join onto the modern; or perhaps I should say that the so-called "Glacial" phenomena *lie in between the true fossil world and our modern one.*

"Thus, in regard to the Pleistocene mammals, the view is now generally accepted that, in every place where they have been found in a contemporary bed, that bed *underlies the till, and is therefore pre-Glacial.* As in other places, so here [Scotland], teeth and bones of mammals have occurred in the clay itself; but in all such cases they occur sporadically and as bowlders. As Mr. James Geikie says, 'They almost invariably afford marks of having been subjected to the

[17] I have left this statement exactly as it appeared in the first edition. But it is interesting to note how this opinion of the inseparable connection with the other geological changes of the ancient shore line around all the continents is supported by Eduard Suess. See "The Face of the Earth," Vol. 2, pp. 497, 550, 554.

same action as the stones and bowlders by which they are surrounded; that is to say, they are rubbed, ground, striated, and smoothed.'"[18]

And again:

"The Pleistocene fauna, so far as I know, came to an end with the so-called Glacial age."[19]

From a recent notice in *Nature*,[20] it would seem that even Dr. H. Woodward, of the British Museum, supports this general view in his "Table of British Strata," by the statement that the Glacial deposits contain *only derived fossils.*

But this is so decided a simplification of the problem of climate that I am utterly at a loss to understand how anyone can still cling to the complex and highly artificial arrangement of numerous "interglacial" periods, to account for a few bones of mammals or a few pockets of lignite; and how they can even place between the "Glacial period" and our times the "genial Champlain period," with it, as Dana says, *"abruptly terminated"* and becoming *"suddenly* extreme as of a single winter's night." Howorth, in the latter part of the chapter already quoted from,[21] gives a good review of this subject of intermittent climates, and strongly supports his contention that the stratigraphical evidence all points to the fact that the Pleistocene forms are always older than the Drift beds, and where the flora and fauna of the Pleistocene occur in the Drift, they do so only

[18] "Great Ice Age," p. 129; "Nightmare," p. 473.
[19] Id., p. 463.
[20] April 11, 1901, p. 560.
[21] "Nightmare," pages 460-478.

as bowlders; that, in fact, as he says in his Preface, "the Pleistocene Flood . . . *forms a great dividing line* in the superficial deposits," separating the true fossil world from the modern. But when this much is settled, the rest becomes very easy.

IV

I do not think that any further words of mine are needed here to remind the reader of the fanciful and unscientific way in which the subdivisions of the Tertiary are marked off, or in which the Pleistocene itself is separated from the Tertiary. I quite agree with the wise words of an old geological writer, who, more than seventy-five years ago, entered a protest on this point before the Geological Section of the British Association for the Advancement of Science. I quote some of his strong but truthful words:

"The whole Tertiary strata cover but a small portion of the face of our globe, and each of the four sections [the Pleistocene used to be included in the Tertiary] can claim but a few patches; *yet to* [*each of*] *these patches an age is assigned!* What became of the rest of the earth, when one of these sections, say, the Miocene, had its reign? Did the process of life stand still elsewhere, while a few Miocene spots monopolized the concerns of the living world? Or was there a general Miocene creation, the whole of which was lost, except these favored spots, before the Pliocene era began? *To give the dignity of a world to such insignificant patches, is like attempting to erect a pyramid on a single point.*"[22]

In one of the previous chapters I have tried to show the utter nonsense of the common custom of classifying these beds according to the percentage

[22] "Scriptural Geology," George Young, 1838, p. 20.

of living and extinct forms which they contain, when the real fact is that the number and kinds of the ancient life-forms which have survived into the modern era is a purely fortuitous circumstance, being limited solely to those lucky ones which could stand the radical change from a tepid water or a genial air to the ice and frosts they now experience, to mention only one circumstance of that cosmic convulsion which we now know to have really intervened between that ancient world and our own. *Yet it is on such evidence only* that these Pleistocene forms are separated from the Tertiaries, or that the Tertiaries themselves are classified — at least so far as the Invertebrates and the plants are concerned.

No one claims that the so-called Glacial beds can be sharply distinguished from other deposits on purely mechanical make-up. Indeed, I am strongly of the opinion that very many Archæan soils, totally unfossiliferous themselves, and resting on unfossiliferous rocks, have been assigned to the "Glacial age" merely because their discoverers did not know what else to do with them. When beds contain characteristic fossils, the latter are the *one and only guide in determining age;* but in view of the purely arbitrary character of this method of classifying the Tertiary and the Post-Tertiary rocks, I do not see where we are going to draw the line when we once admit that the Post-Tertiary beds contain only "derived fossils." It seems to me truly astonishing that shrewd reasoners, like Howorth and Dr. Woodward, have not seen the dangerous character of this precedent which

they have admitted; for with that marvelous climate of all geological time continuing right up to that fatal day when it was "abruptly terminated," and the mammoth and his fellows were caught in the merciless frosts that now hold them, the percentage of all the lucky forms of life, plants, invertebrates, or mammals, that could stand such a change and "persist" into our modern world, must be utterly nonsensical as a test of age even from their standpoint.

V

In resuming the main argument of this chapter, I need only summarize by saying that the evidence is conclusive that all geological time down to this "great dividing line" was characterized by a surprisingly mild and uniform climate over all the earth, for there is only one climate known to geology proper. The modern period is characterized by terrific extremes of heat and cold; and now little or nothing can exist where previously plant and animal life flourished in profusion.

This radical and world-wide change in climate, therefore, demands ample consideration when we seek a true induction as to the past of our globe. That it was no gradual or secular affair, but that the climate "became *suddenly* extreme as of a single winter's night," the Siberian "mummies" are unanswerable arguments. That it was a universal influence, affecting the whole world, is the argument from common sense. *That it occurred within the human epoch, all are now agreed.*

CHAPTER XI

Degeneration

I

THERE is another great general fact about the fossil world which seems to be a natural corollary from the one already given about climate.

It is this:

The fossils, regarded as a whole, invariably supply us with types larger of their kind and better developed in every way than their nearest modern representatives, whether of plants or animals.

By this I do not mean that there were huge monsters in that ancient time; although we know that such monsters did exist. What I mean is that, wherever we can get at the fossil forms corresponding to the various living genera and species, we almost invariably find that the fossils are larger and more thrifty looking than their modern representatives.

On a previous page, I have shown good reasons for believing in wide variations among plants and animals. Mendelism has helped us to see how these variations may have come about; though I suspect that this is only part of the truth, and that even much wider divergence from the original type may have taken place in the past, that is, a wider divergence than anything we can produce to-day by our experimental breeding. Yet all these studies tend to prove

even more conclusively that there are real groups of related organisms, which are different from all other groups; these great original groups being probably what we now call the *families*. The genera, species, and varieties would then be only varying grades of classification under the original type, which is the *family*.

II

That this principle runs through the whole range of both the plant and the animal kingdom, is not at all surprising, in view of the climate in which those ancient plants and animals lived. According to the rule laid down by Joel Asaph Allen, in his "Geographical Variation Among North American Mammals," climate is the chief factor in the development of both the individual and the species. This author's first rule along this line is as follows:

"The maximum physical development of the individual is attained where the conditions of environment are most favorable to the life of the species."

And the second rule is in accord with the first:

"The largest species of a group (genus, subfamily, or family, as the case may be) are found where the group to which they severally belong reaches its highest development."

And the fact that we find better developed specimens among the fossils of any given group than we find among the corresponding living forms, is only a corollary from the great fact already stated regarding the climate of that ancient world.

This general fact about this characteristic of the fossils will not be questioned by anyone acquainted with them in a broad way. Through the whole range of geological literature, I do not know of a word of dissent from this general fact by any writer whatever. Proof, therefore, is not necessary, though a brief review of a little of the evidence may refresh our memories.

And the point to be especially noted here is that this remarkable peculiarity is characteristic of *all* the fossils; whereas, when we cross over into our modern era, *the change is just as sudden and complete as is that of climate.* Our modern plants and animals, whether in the sea or on the land, are degenerate dwarfs.

III

To begin with the Cambrian, Dana says:

"The pteropods, among mollusks, were much larger than the modern species of the tribe. The trilobites even of the Lower Cambrian comprise species as large as living crustaceans. The ostracoids are generally larger than those of recent times."[1]

Again, in speaking of the general character of the Cambrian fossils, he says:

"The types of the early Cambrian are mostly identical with those now represented in existing seas, and although inferior in general as to grade [in the "phylogenic series"], they bear no marks of imperfect or stunted growth from unfit or foul surroundings."[2]

[1] "Manual," p. 487.
[2] Id., p. 485.

The well-known mollusk, *Maclurea magna,* which is so enormously abundant in the Silurian, is often eight inches in diameter; and the astounding cephalopod genus, *Endoceras,* consisting of twenty species, found only in two divisions of the Ordovician, has left shells more than a foot in diameter and ten or fifteen feet long!

Of the fishes of the Devonian, we have, among other remarks of a similar character, the following:

"The dipnoans, or 'lungfishes,' were represented by gigantic species called by Newberry *Dinichthys* and *Titanichthys,* from their size and formidable dental armature. . . . A still larger species is the *Titanichthys clarki* of Newberry, in which the head was four feet or more broad, the lower jaw a yard long. This jaw was shaped posteriorly like an oar blade, and anteriorly was turned upward like a sled runner."[8]

One of the ancient eurypterids from the Old Red Sandstone of Europe has a length of six feet, which is more than three times that of any crustacean now living; while a gigantic isopod crustacean from the same strata had a leg the basal joint of which was three inches long, and three quarters of an inch through, which is larger than the whole body of any modern species.

The ancient horsetails, ground pines, ferns, and cycads were trees from thirty to ninety feet high, and their carbonized stems and leaves make up many of our largest and best beds of coal. Compared with them, the modern representatives are mere herbs or shrubbery.

[8] Id., pp. 618, 619.

Of the gigantic insects of the Devonian and Carboniferous beds, we might make similar remarks. Some of the ancient locusts had an expanse of wing of more than seven inches; while many of the ancient dragon flies had bodies from a foot to sixteen inches long, with wings a foot long and more than two feet in spread from tip to tip.

Here is James Geikie's summary of the leading types of the Paleozoic:

"Many Paleozoic species were characterized by their large size as compared with species of the same groups that belong to later times. Thus, some trilobites and other crustaceans were larger than any modern species of crustaceans. The Paleozoic amphibians also much exceeded in size any living members of their class. Again, the modern club mosses, which are insignificant plants, either trailing on the ground or never reaching more than two feet in height, were represented by great lepidodendroid trees."[4]

Sternberg, in speaking of some of the frogs he found in the Permian of Texas, says:

"I found several skulls that measured over a foot from the end of the chin to the distal point of the horns. . . . I think when alive the frog must have been six feet long."[5]

He mentions another specimen that was "about ten feet long," the head of which was "about twenty inches in length," with jaws "more powerful than those of an ox."

Of the monstrous dinosaurs of the Mesozoic rocks, one hardly needs to speak.

[4] "Historical Geology."
[5] *Popular Science News*, May, 1902, p. 106.

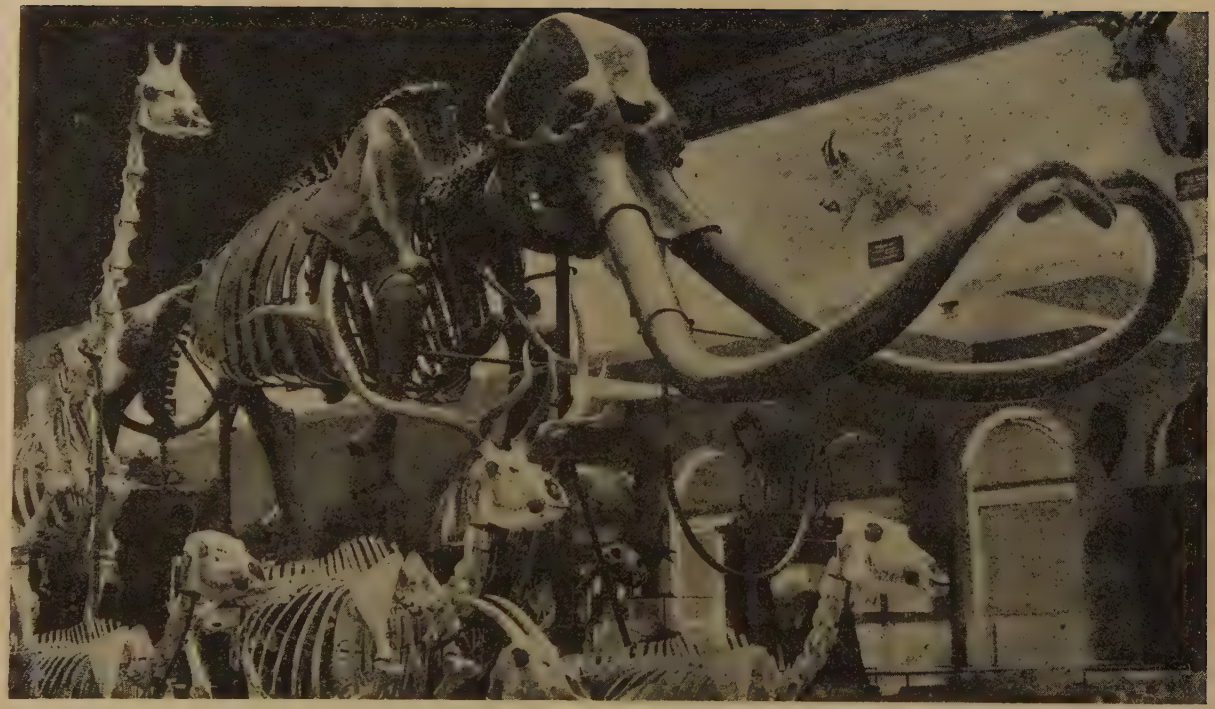


FIG. 77. A view of the skeleton of the imperial elephant on exhibition at the Museum of History, Science, and Art, in Los Angeles. Compare him with the giraffe beside him, or with the big buck in the foreground. The imperial elephant in the Pleistocene epoch ranged west of the Mississippi southward from Nebraska to the City of Mexico.

"They were the most gigantic of terrestrial animals, in some cases reaching a length of 70 or 80 feet, while at the same time they had a height of body and massiveness of limb that, without evidence from the bones, would have been thought too great for muscle to move."[6]

They abound in both the Old and the New World. Of the gigantic mammals of the Tertiary beds of the Western States, it would also be superfluous to speak; their gigantic size is known by every high school pupil, and by every one who has visited any important museum in Europe or America.

We may perhaps be reminded again that all the species of these "older" rocks are *extinct species*. I have already suggested the grave doubts on this point, regarding the great mass of the lower forms of life (pp. 166-195), plant and animal; but we will let that pass. But let us take some of the "late" Tertiary and Pleistocene mammals, which can not be distinguished from living species, and how do we fare? It is the same old story; the modern are degenerate dwarfs.

The hippopotamus (*H. major*) is a good one to start with, for Flower and Lydekker[7] say that it "can not be specifically distinguished from *H. amphibius*" of Africa. This gigantic brute used to live in the rivers of England and western Europe. The textbooks generally say, in "Pliocene times," because, I suppose, no one has the courage to suggest that it lived under the ice of the "Glacial period." We are always pointed to the hair on the rhinoceros and the

[6] "Manual," Dana, p. 761.
[7] "Mammals," etc., p. 281.

mammoth as indicating a somewhat cool climate, but the well-known amphibious habits of the hippopotamus can not be so easily disposed of. But if, as I believe, this world never saw a foot of ice at the sea level till the end of the "Pleistocene period," to speak after the current manner, the problem becomes very simple. In that case, the time of the hippopotamus in England was neither earlier nor later than that of the palms and acacias of the "early" Tertiary or Mesozoic rocks, or than that of the mammoth, lion, and hyena of the Pleistocene. There is, as we now know, absolutely nothing but an out-of-date hypothesis to indicate that they did not *all live there together.*

As for the mammoth itself, which Flower and Lydekker have intimated may turn out identical with *E. columbi* and *E. armeniacus,* and thus the direct ancestor of the modern Asiatic elephant (*E. indicus*), some have argued that its average size was not greater than that of the existing species of India and Africa. But Nicholson says that it was "considerably larger than the largest of living elephants, the skeleton being over sixteen feet in length, exclusive of the tusks, and over nine feet in height."[8]

Dana is equally positive:

> "The species was over twice the weight of the largest modern elephant, and nearly a third taller."[9]

Grabau says that the mammoth was fourteen feet high, or three feet taller than the great African ele-

[8] "Ancient Life-History," p. 357.
[9] "Manual," p. 998.

phant, Jumbo.[10] In the Exposition Park Museum, Los Angeles, California, is a specimen of an elephant called *E. imperator,* which is fifteen feet high. It is doubtless identical with the other true elephants, *antiquus, primigenius,* etc., though handicapped with a distinct specific name.

The upper incisors, or tusks, were very much longer than in the modern species, being from ten to twelve feet long, and sometimes curved up and back so as to form an almost complete circle. As these tusks continue to grow throughout life, their enormous length is, I take it, a proof of much greater longevity and thus of greater vitality than in the case of the modern species. The latter is simply a degenerate.

IV

And so I might go on with the edentates, the ungulates, the rodents, the carnivores, etc., for the same thing must be said of all.

As Sir William Dawson remarks:

> "Nothing is more evident in the history of fossil animals and plants of past geological ages than that *persistence or degeneracy is the rule* rather than the exception. . . . We may almost say that all things left to themselves *tend to degenerate,* and only a new breathing of the Almighty Spirit can start them again on the path of advancement."[11]

In spite of the long-popular views of Cuvier, every modern scientist admits that the great lion and hyena of the Pleistocene are identical with the

[10] "Textbook," Part 2, p. 860.
[11] "Modern Ideas of Evolution," Appendix.

living species of Africa. Many say the same thing of the fossil bear as compared with the modern brown bear and the grizzly, though, as Dana remarks of all three, lion, hyena, and bear, "these modern kinds are dwarfs in comparison."

J. A. Howe of the Museum of Practical Geology, London, has given us the following positive testimony:

"*Elephas antiquus,* for instance, attained a more excessive bulk than any other proboscidian either before or since, the woolly rhinoceros, the great hippopotamus, the cave bear, cave lion and giant deer were all larger than their living representatives."[12]

I quote again from Dana:

"Thus the brute races of the Middle Quaternary on all the continents exceeded the moderns greatly in magnitude. Why, no one has explained."[13]

This was in 1875. In the last edition of his "Manual," published shortly after his death, he has this to say in addition:

"A species thrives best in the region of fittest climate. *In the Pleistocene, the fittest climate was universal.* Geologists have attributed the extinction of most of the species and the dwindling of others to the cold of the reindeer epoch. It is the only explanation yet found, though seemingly insufficient for the Americas."[14]

However, since the discovery of the pictures of the reindeer and the mammoth drawn and even painted side by side on the caverns of southern France (Figs. 78, 85, 86), undoubtedly from life and by the same

[12] Encyclopedia Britannica, Art. "Pleistocene."
[13] "Geological Story Briefly Told," p. 229.
[14] Page 1016.

artists, we do not hear so much about the "reindeer epoch" and the "mammoth epoch." A little thought should have suggested long ago that it was more reasonable to suppose the reindeer, the glutton, the musk ox, etc., to have been originally adapted to the high mountains and table-lands of that ancient world than to imagine all the fauna careering up and down over continents and across seas like a lot of crazy Scandinavian lemmings, as the migration theory involved. But most geologists seem never to have had any use for mountains or plateaus, except to breed glaciers and continental ice sheets. However, the only point which I wish to insist upon here is that the cause, *whatever it was,* that made such a zoölogical break at the "close" of the Pleistocene, and which compelled the shivering, degenerate survivors, that could not stand the new extremes of frost and snow, to shift to the tropics — this cause was certainly competent to do a good deal more work in the way of "extinction" or "dwindling" of species than the uniformitarians have generally given it credit for.

And in summing up this matter regarding the size and physical development of species, we must confess that we find in geology no indication of inherent progress upward. Variation there is and variation there has been, perhaps even "mutations" and "saltations" that seem like the origin of veritable "new species." But with one voice do the rocks testify that the general results of such variation have not been upward. Rather must we confess as a great biological law, that *degeneration has marked the history of*

every living form. Even more important is the fact that this change from the larger ancient forms to the smaller modern ones *is abrupt and complete over the whole globe,* and coincides exactly with the change from the fossil world to the modern one.

Surely, these facts taken together, and especially when correlated with the other facts set forth in previous chapters, prove a gigantic world-catastrophe of some kind; or else there can be no meaning whatever to scientific evidence.

CHAPTER XII

Fossil Men

I

There is still another fact which we must consider ere we can frame any wise or safe induction regarding the geological changes. It is this:

Man himself, to say nothing of numerous living animals and plants, must have witnessed something of the nature of a cosmic convulsion—how much, it is the object of our search to find out. Even according to the ordinary textbooks, he must have seen the uplifting of the greater part of the mountain chains of the world; while he certainly lived in conditions of climate, and of land and water distribution, together with plant and animal surroundings, which preclude the possibility of dovetailing those conditions into the present order of things on any basis of uniformity.

By this proposition, I simply mean that *man must have witnessed a cosmic geological catastrophe of some character and of some dimensions.* The true nature and probable limits of this catastrophe ought to be the chief point of all geological inquiry. But instead of this method—instead of finding out whether our present world was ever a witness of such an event—the founders of the science began at the little end of an assumed succession of life (involving a preposterous supernatural knowledge of the past),

and gradually worked up a habit of explaining everything in terms of uniformity, long decades before they would acknowledge that man or the present order of things had anything to do with this fossil world. The evidence on this latter point finally became overwhelming; but with their habit of uniformity well mastered, and their long, single file of life-succession all tabulated and infallibly fixed in a definite serial order, modern geologists have hitherto refused to look at the whole science from this new point of view, or to reconstruct geological theory if need be in accordance with a true modern induction.

II

This problem regarding prehistoric man,—the length of time he has been on earth, his condition at the beginning, and his relation to the great world changes that have unquestionably taken place since he came into existence,—has long been regarded as one of the most perplexing in the whole realm of science. For decades, the world was agitated over the problem of the origin of races, whether man originated from one race or several. Aristotle and the other ancients had regarded it as a very simple thing to account for the different races of mankind by the effects of climate, food, occupation, and such things. But our more precise modern knowledge has taught us that the problem is not by any means so easy. These influences are now known to be so slight in amount and so slow in operation, and so ambiguous, that it becomes almost a hopeless task to account for

the diversities of the various races in any amount of time by these agencies alone and without some abrupt change that could be little short of miraculous.

This line of argument finds support in the remarkable permanence of types displayed by various races after being transplanted to other climates and other habits of life. Again, peoples like the Bushmen and the Negroes may live for long periods side by side under the same conditions of climate without becoming in any way more alike. On the other hand, the forest tribes of tropical Brazil show a striking resemblance to the coast tribes of Tierra del Fuego, in spite of extreme differences in climate and food. Last of all, the monuments of Egypt show that back at the very dawn of history, the various races were apparently just as distinct as to-day in color, hair, and features. All these things have made it hard to understand how such diverse races as the Negro, the Mongolian, and the Caucasian could possibly be derived from a common stock without something very much like a miracle.

Philology, or the study of languages, has given us about the same result; for fifty or seventy-five distinct types of language have been made out, such that no one kind can be considered to be derived from any other; and yet we can not understand how a language can ever be so completely transformed from within as to lose its original roots entirely, and even change its entire plan of structure. But in spite of all these considerations, the unity of the human race is much more generally accepted now than ever before. The popular geological notions have made

people familiar with the idea of almost unlimited periods of time; and in this, as in geology proper, scientists have tried to persuade themselves that a greatly extended period of time might help to solve the problem.

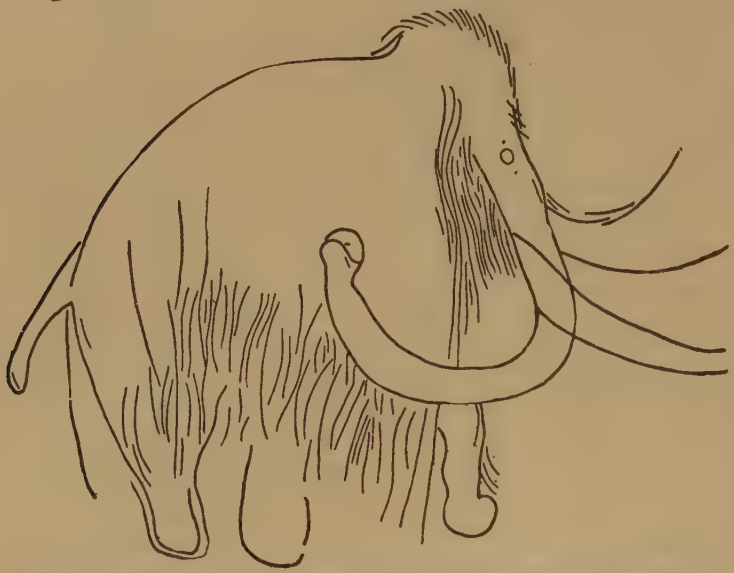


FIG. 78. Engraving of a Mammoth. Cavern of Les Combarelles (Dordogne). 1-7. (After Capitan and Breuil.)

III

As already remarked, Cuvier and his followers not only denied that human remains are ever found fossil, but denied most positively that any living species is to be found in the fossil state. The earliest reports of the finding of human remains in geological deposits, as given by Tournal and Christol in 1828, by Schmerling in 1833, or even those of M. Boucher de

Perthes in 1841-1847, were largely ignored; but from this point onward, the French and the English geologists began to consider the matter more carefully, and they thought they found irresistible evidence that man lived contemporary with the Pleistocene fauna. Godwin-Austen, as early as 1840, had described human remains which he found mixed up with those of the mammoth, rhinoceros, and other Pleistocene forms, in Kent's Cavern, England; and a few years later similar cave deposits were discovered in France, culminating in the sensational find of Lartet and Christy (1865) of some drawings of reindeer on a piece of horn, and a sketch of a mammoth, showing its tusks and long hair, on a piece of mammoth tusk from La Madeleine.

From this point the work of discovery went steadily forward, with almost every new find carrying the antiquity of man farther back into the Tertiary period, until we have the earliest trace of man placed in the "Middle Oligocene," and more definite human remains placed in the "Middle Miocene." So far as I know, this represents the high-water mark in the claims for the "antiquity" of man.

But presently evolutionists took alarm. What they wanted was *time;* and they certainly were getting plenty of it. A few million years would be a moderate estimate of the time since the profuse Miocene flora existed all over the arctic regions, according to the popular theory. The thing was getting too absurd. Would not the same *purpose* be attained by simply stretching out the Pleistocene to a

little greater dimensions, and then having the human epoch fall more comfortably within it, thus saving the risk of having man alive when too many and too alarming geological changes were going on?

At any rate, this is about the turn which these matters have taken within recent years. Most influential writers along this line have placed the Java skull within the "latest" part of the Pliocene, and all the other specimens within the Pleistocene, or Quaternary; though, of course, the Pleistocene is now being stretched out enormously, so that the absolute time represented in this way is not materially changed, most writers being quite willing to assign a million years or so for the total time since man first changed from the "walking ape" into his present physical form.

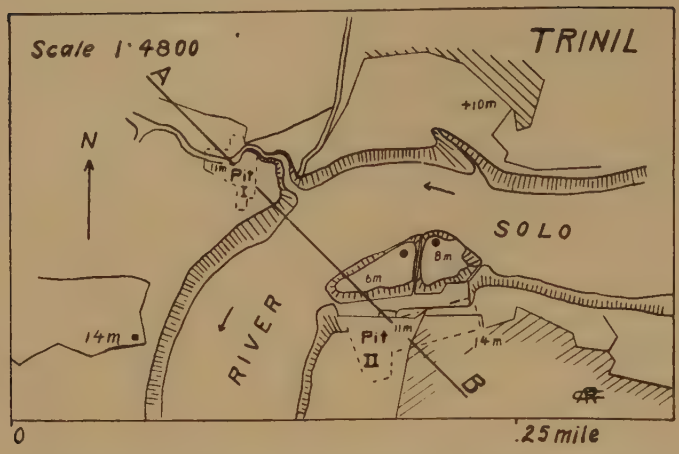
The subject is still under discussion as to *just how far back,* along this thin line of receding life-forms, man actually did live; and from the peculiar methods now in vogue, which are wholly subjective in character, it would seem to be capable of settlement in almost any way one chooses. Thus, a very high authority, in speaking of the river terraces in which these most ancient human remains are found, remarks, "It is by no means easy, in the present state of the land surface and with our present knowledge, to place the remains in their relative sequence."[1] However, whole volumes are being written on the subject, and the end is not yet. The whole matter is in a state of chaos, each writer working out a chrono-

[1] Encyclopedia Britannica, Cambridge University edition, Vol. 2, p. 246.

logical scheme in accord with what he thinks *ought* to be the case, and the objective evidence being of such an ambiguous character and the rules governing both the classification of the human remains and the geological age of the beds in which they occur being so entirely theoretical and subjective, that it is quite possible to arrange the chronological scheme in almost any way one may see fit.

IV

In all this, of course, I am considering the question from the common uniformitarian standpoint. But why should it be necessary for us to settle positively the question as to just how far back in "geological time" man actually did live? For those who have attentively read my statement of the unscientific methods of classifying these Tertiary and Post-Tertiary beds — or all the others, for that matter — I need not here add any further argument. If the accepted succession of life is, to put it as mildly as possible, not quite a scientific certainty; if the time-honored custom of classifying these so-called "superficial" beds by their relative percentages of extinct and living forms rests under a shadow of suspicion as to its scientific accuracy; if, above all, we do not, at the beginning, prejudice the whole case by the assumption of uniformity,— then *what need is there of determining whether "Pliocene" or "Miocene" shells are found with these fossil human remains?* What material difference can it make, in a serious, scientific treatment of this problem, whether



Outline Map of the Excavations (Pits I and II) Trinil, Java. (After M. L Selenka, 1911)

- *Monument*
- .. *Places where remains of Pithecanthropus erectus were found by Dubois, 1891-1892.*

A-B, Line of Geologic Section.

FIG. 79. Map of locality where the remains of *Pithecanthropus erectus* were discovered. (American Museum of Natural History, New York City.)

five per cent or twenty-five per cent or ninety-five per cent of the associated mollusks belong to "species" classed as "extinct"?

That man lived in western Europe contemporary with those giants of the prime,—the elephant and the rhinoceros, the lion, the Cape hyena, and the hippopotamus, at which time a very different distribution of land and water prevailed over these parts,

with a radically different mantle of climate spread over all,— no one will deny for a moment. Such facts are now found in the primary textbooks for our children in the public schools.

However, with the chaos prevailing on this subject regarding the antiquity of man, it will be best for us to confine ourselves to well-known facts. And we can not do better than to present here the leading facts regarding the four most famous specimens of prehistoric man, the four which all evolutionary geologists and archæologists regard as the very oldest specimens yet discovered.

V

We must begin with the famous *Pithecanthropus erectus,* a name given to the relics found by Dr. Dubois, a Dutch army officer, in 1891, on the left bank of a stream near Trinil, in central Java. He first found the cap of a skull and a molar tooth. Next spring he found a left femur about fifty feet from the first locality, also a second molar tooth. Some time later another molar tooth was discovered. The locality was one where various fossils of animals had been found previously, and where others have been found since, the geological date of the beds being given variously as Pliocene and Pleistocene. We know how extremely difficult it is to decide such a momentous question.

Only the cap of the skull was found; and this again offers more opportunity for uncertainty. In reconstructing this skull, it has been stated to have a

capacity of about 28 ounces. No normal brain weighs less than 30 ounces, the average being about 49 ounces. Accordingly, this Java skull has been pronounced by various persons as that of an idiot, that of a sub-man or ape-man, or that of a large *Hylobates,* or gibbon.

When these remains were first brought to Europe, Virchow, the foremost authority of that time, declared

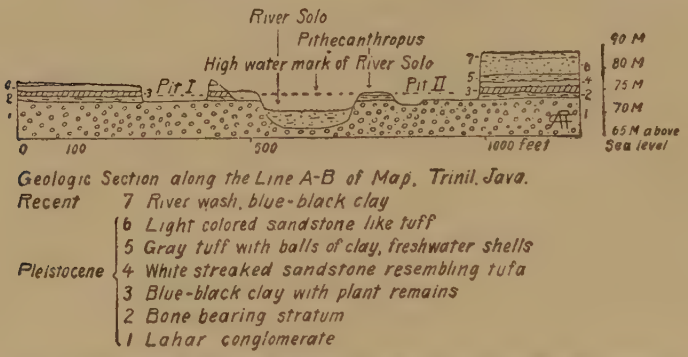


FIG. 80. Geologic section across the Solo River at the point where the skull-cap of *Pithecanthropus* was discovered. Note that the river, at high water, overflows this point. This same layer has yielded many bones of mammals, some apparently belonging to modern species, though this bed is usually classed as Pliocene-Pleistocene. (After Osborn.)

this skull to be that of a gibbon. The same opinion has been expressed by many others. Richard Hertwig says: "The opinion that is most probably correct is that the fragments belonged to an anthropomorphic ape of extraordinary size and an abnormal cranial capacity, and with a relatively large brain."[2]

Nothing but its large size would hinder anyone from calling it an ape. Macnamara declared it to be

[2] Quoted by T. B. Bishop, "Evolution Criticized," p. 34.

an ape's skull. This opinion is agreed to by many leading German authorities, including Klaatsch and Branca, the latter being professor of geology and paleontology in the University of Berlin. As we have already learned that most fossils are larger than their corresponding living representatives, no mere question of size ought to stand in the way of our supposing this to be the remains of a large gibbon, the only ape that habitually walks in an erect position.

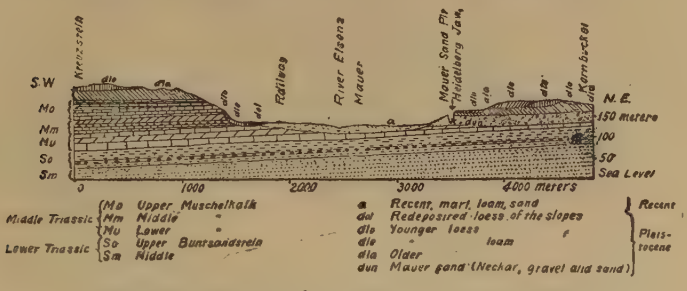


Fig. 81. Geologic section where the Heidelberg jaw was found. (American Museum of Natural History, New York City.)

Our second archæological specimen is the Heidelberg jaw. This was found in 1907 in a sand pit at Mauer, near Heidelberg, Germany. The bank in which it was found contained some 24 distinct layers, the fossil being in the lowest of them, some 78 feet below the surface. The geological age of the bed is usually given as corresponding to the Cromer forest bed, or Norfolkian, a subdivision of the Pleistocene, but well back in the "Glacial Age."

The crowns of four of the teeth had been broken off by accident; the rest were intact, and were of

normal size and pattern. But the jaw itself is very large, with a huge ascending ramus, and has no chin.

From this it will be seen that we do not have very much on which to build a picture of what this ancient man was like. But a skull has been imagined to fit this jaw, and it has been made the subject of much learned discussion.

The third place in point of antiquity is assigned to the Piltdown skull. The fragments of this skull

FIG. 82. On the left is the "Piltdown Man," made up of seven fragments of bone, four from a skull, one from a nose, one tooth, and piece of jaw over which scientists are not agreed. The time of finding, from autumn to spring. The spot, several yards in area. Rather uncertain. On the right is the "Heidelberg Man" of whom only a jawbone was found. The imaginative conception of man gave us this head to fit that jawbone. Hardly conclusive.

were found on a high plateau, or river terrace, in 1913, at Piltdown, Sussex, England. This skull has been rated older than the Heidelberg jaw; but, according to most authorities, it should come after it.

This skull has been reconstructed by various scientists, and has been made to have a capacity of about 43 ounces, or slightly below that of the average male skull of to-day, and almost exactly that of the average female skull, which is rated at 44 ounces. The bone

of the brain case is very thick, and, as usually reconstructed, the fore part of the face is quite prognathous, or snouty; the forehead is not receding, but of good form, though somewhat narrow. Its jaw, however, has no chin, and has a large ramus like the Heidelberg specimen.

Considering that the various fragments composing this skull were found scattered over an area of several yards, part being found in the autumn and part in the spring of the next year, it may well be surmised that we can not be very certain about the size and shape of this skull. In point of age, Keith calls these fragments Pliocene, while Smith Woodward assigns them to the Pleistocene. The skull is usually regarded as that of a woman.

The fourth on our list is the Neanderthal skull. This was found as long ago as 1857, and since then a sufficient length of time has elapsed to produce a large literature dealing with its probable age and relationships. It was merely the cap of the skull that was found, and no human implements or the bones of any extinct animals were found along with it. It was not discovered by any responsible scientist, but by some workmen, who seem to have been quite careless and to have preserved only the largest bones. The find was made in a cave; but it is at this date impossible to say whether it represents a burial by friends or whether it had been washed into this cave from the surface of the ground outside.

Virchow pronounced this Neanderthal skull a pathologic specimen, but declared that he had seen

men walking the streets with very similarly shaped craniums. Other scientists, however, have pointed to the very prominent ridges above the eyes, and to the very long and almost flat form of the head as signs of its being of a low or pithecoid type.

In 1886, at Spy, near Namur, Belgium, were found two nearly complete skeletons, which were regarded as similar to the skull from Neanderthal, and led to

FIG. 83. Skull of the "old man" of Cro Magnon. (American Museum of Natural History, New York City.)

the assigning of all these to a distinct species of mankind, *Homo neanderthalensis*. These remains were evidently buried by friends, though in the same deposits were found the remains of the great bear (*Ursus speleus*), the mammoth (*Elephas primigenius*), and the rhinoceros (*R. tichorhinus*). A geological study of the locality proves that the present valley of the Orneau, the stream flowing by the cave containing these remains, was already nearly completely formed when the bones and other *débris* were depos-

Fig. 84. Some of the most famous skulls. In the upper right-hand corner is shown the printed card stating "How the Antiquity of Man is Estimated," a full reproduction of which is given in the text. (American Museum of Natural History, New York City.)

ited in this cave, among which these skeletons were afterwards interred.

We have now studied all of the human remains upon which the great antiquity of man is founded. The three skeletons found at Cro Magnon, Dordogne, France, are also very famous; but they are such astonishingly well-developed specimens that anthropologists will not admit them to be very old,—that is, in the geological sense. The old man of Cro Magnon was six feet one and a half inches tall, the skeleton showing "evidence of immense muscular development,"[3] and the brain being equal to that of Bismarck, according to one authority. Evidently he was a very old man, for the teeth were all worn off almost to the sockets, though all the teeth were sound. Keith declares that this race "was the finest the world has ever seen"; while Macnamara, in alluding to it, says that the tradition of a "race of giants in far-distant times was no myth."

VI

We must now turn to the rules under which the antiquity of man is estimated by those who make these matters the business of their lives. A set of rules governing this subject was at one time posted in one of the glass show cases containing human skulls and models, in the American Museum of Natural History, New York City, of which Henry Fairfield Osborn is the curator. These rules follow:[4]

[3] Dawson.

[4] I copied this set of rules as displayed in the summer of 1920. When I again visited New York in the spring of 1922, this card giving this set of rules had been removed.

"How the Antiquity of Man Is Estimated

"The dating of human skeletal remains is at best only a rough approximation. The probable error of our estimate would undoubtedly be expressed in thousands of years. Nevertheless we have several guides in determining the probable position in time of a given find.

"The first and best indication is afforded by geological records. Geologists know that the sands, gravel, loam, and loess of certain localities were deposited by glaciers, rivers, or winds during certain geological periods. Another valuable guide is the association of human remains with the skeletal remains of animals now extinct. Paleontologists have a fairly clear idea as to the time at which these animals became extinct. A third indicator is the kind of articles of human manufacture found with the skeletons. Archæologists have a general idea of the gradual development of human industries in Europe up through the exclusive use of rough stone implements to the more finely finished products of polished stone, bone, copper, bronze, and iron. Finally the nature of the skeletal remains themselves affords an indication of their probable place in man's evolution.

"The attitude of modern science is decidedly critical, and not until a given specimen has been subjected to the above four tests is it finally assigned to a definite place in man's history. Many finds, which have failed to satisfy the demands of science on one or more of the four points of geological position, associated animal remains, associated implements of human manufacture, and morphological form, have been temporarily placed to one side to await the possibility of future discoveries throwing some light on their true position."

If any comment is necessary on these four candidly expressed rules, it surely must be brief. The first of these rules has whatever value the reader thinks still attaches to the geological classifications, after reading the previous pages. The second rule labors under the danger of not always being clear or reliable, since, if we find human remains mingled with

the fossils of extinct species, the latter may have been lying around on the top of the ground like bowlders, and remains of man very subsequently formed may have been mixed with them in this way. Or again, if human remains are found buried by friends among strata containing fossils of true geologic age, this is good evidence that these human remains are post-

FIG. 85. Unfinished polychrome painting of two reindeer, showing how painting was combined with engraving. Cavern of Font-de-Gaume (Dordogne). 1-20. (After Capitan and Breuil.)

geological, if I may be allowed to coin a term. The third rule is fairly good, though of very limited use; while the last rule assumes the whole theory of the ape origin of man to begin with, and deliberately judges all evidence in the light of this prejudice, and any evidence not in accord with this prejudice is "temporarily placed to one side."

In the light of these facts, it seems hopeless to get at the real truth with regard to this vexed matter

of the antiquity of man. There can be no scientific value attaching to the ordinary classifications of human archæological remains, when such rules and such methods have been employed in making these classifications. Personally, I believe that man was most certainly contemporary with those giant animals which we find as fossils in the Pleistocene and the Tertiaries. But I can not put my finger on any particular fossil human specimen which I think proves

Fig. 86. Red Drawing of *Rhinoceros tichorhinus*, from Font-de-Gaume. (After Capitan and Breuil.)

this satisfactorily; and on this account, anyone is at liberty to call this belief of mine a prejudice. Be it so. But as it happens to be a prejudice that is in exact accord with the current teachings of science, I may possibly be able to get a hearing for an argument based upon this fact,—an assumed fact, so far as I am concerned, since I can not prove it scientifically; but a fact that most people think has been proved in another way, though I deny the value of this other line of proof.

But with this *modus vivendi* between me and my readers, we may resume our study of the characters of some of these early men, whom I believe to have lived very soon *after* the world changes recorded in the rocks, but whom most scientists believe to have lived contemporary with the mammoth, the rhinoc-

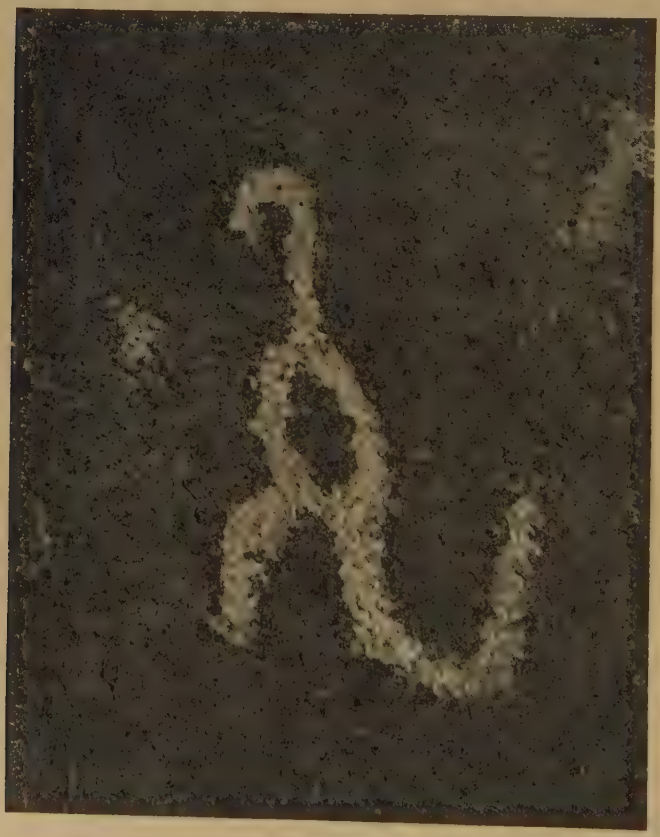


FIG. 87. The drawing of the dinosaur on the walls of the Hava Supai Cañon, Arizona.

eros, and the great lion and the great bear in western Europe.

VII

Reference has already been made to the very remarkable carvings and paintings on the cave walls of southwestern Europe. They have been discovered

Fig. 88. *Mylodon robustus.* (After D'Orbigny.)

quite generally throughout this region, and usually consist of carvings of reindeer, aurochs, horses, mammoths, and various other animals, often life-size, and painted in the most astonishing and realistic manner. Scientists are universally agreed as to their great antiquity, for they argue that they must have been done by men familiar with the forms depicted, and hence the period of time must have been when the

reindeer and the elephant lived side by side in France and Spain. Besides, the drawings are sometimes covered with limestone stalactites two inches or more thick. The Marquis de Nadaillac, who gave one of the first popular accounts of these discoveries,[5] remarked that "the drawing is wonderful," and that "we are justly astonished to find such artistic performances in times so distant from ours, and in which we did not suppose a like civilization." But the

FIG. 89. *Glyptodon clavipes* (× 1/30).

discoveries that have been steadily made during the subsequent decade have only added to the astonishment of the world at these artistic performances so long hidden from our knowledge. A few words from the Cambridge University edition of the Encyclopedia Britannica will serve to show the verdict of modern scholarship on this point. We are told that these drawings "bring before us a race of artists of first-rate capacity, who, for accuracy of observation and for skill in indicating the character and peculiarities of the animals around them, have never been sur-

[5] *Popular Science News*, February, 1902.

passed.'"[6] But in addition to these life-size drawings and paintings, we have also some very remarkable sculpture work, of which this authority says:

"If we are forced to marvel at the graphic skill of the cave men, their sculptures in the round are on a still higher plane, as may be seen in the figures of reindeer in ivory in the British Museum. While they are not highly finished, they show a complete understanding of the animal's peculiar forms and contours, which are rendered in a direct, unhesitating way that should betoken a long period of artistic training and an executive power uncommon at any time. These drawings and sculptures have always been appreciated and even regarded as being of a much more advanced style than was to be expected among men who are always classed in the lower grades of culture. But enough stress has not hitherto been laid on the artistic quality of the work, which would be considered fine at any time in the world's history. . . . There are many astonishing problems in archæology, but none so badly in need of solution."[7]

The accompanying cuts (Figs. 85, 86) are taken from the Report of the Smithsonian Institution for 1909; but they can convey only a very poor idea of these drawings and paintings as they really are. Two plates in the Encyclopedia Britannica, accompanying the article on painting,[8] may serve to give a better idea of what they are like, also Plates 2 and 3 accompanying the article on archæology.

VIII

But we must now deal with the much more perplexing question of time. When were these drawings made? What people made them? On the accompany-

[6] Vol. 2, p. 347.
[7] Ibid.
[8] Vol. 20, p. 462, Plates 1 and 2.

ing diagram, which is taken from the article by G. G. MacCurdy, in the Smithsonian Report for 1909, already referred to, these drawings are assigned to the Upper Paleolithic "period," which corresponds with the Upper Quaternary "period" of geology. These drawings are almost universally assigned to the Cro Magnon "race," so named from a locality in Dordogne, France, where some skeletons were found in 1858. These people of Cro Magnon and Menton were evidently almost a race of giants, some of them being seven feet tall, with a very extraordinary muscular development, as proved by their bones, while their skulls were large and well formed, and, as even an out-and-out evolutionist admits, "their cranial capacity was above that of average Europeans of the present day."[8]

Now if we decide that these Cro Magnon people were the race who did the drawings on the walls of the caves, we are, in effect, assigning them to the Paleolithic period, which is a tolerably well-defined period of antiquity, or at least is separated from the Neolithic period by what archæologists declare is a well-marked break, while the latter period passes by insensible gradations into the modern period. Very likely we shall one day make a distinction between the age in which these men lived and the true geological period when that warm spring-like climate covered all the earth, making the so-called "Ice age" a local affair, confined to only a part of the world, and subsequent to the real geological age, the latter being

[8] N. C. Macnamara, in *Nature*, March 7, 1901.

thus extended to cover all the great geological changes in other parts of the world, including the Pleistocene, or Quaternary. But in the present state of our knowledge, we are not able to effect a reliable scientific classification of these periods. Scientists universally associate these men of the caves with the Pleistocene fauna of Europe, making this "Ice age" the last of the true geological series, though in other lands where the Ice catastrophe did not extend, the Pleistocene blends with the Tertiary without any sharp line of distinction.[10]

Thus there is no valid reason, from the common viewpoint, for saying that these Cro Magnon men were not contemporary with the fauna of the Pliocene or, possibly, the Miocene. At least *some men were, as commonly admitted;* and why not these as well as any others? For if we admit that any human remains whatever are of real geological age, it is only a very artificial distinction that will separate "Glacial" man from the men of the Middle Tertiary period.

[10] Stated in terms of Bible history, this would mean that these men of the caves were not really antediluvian, but only very early postdiluvian; that they were acquainted only by tradition with some of the animals they have depicted; and that where their bones are found along with those of the elephant, the rhinoceros, etc., in the latitude of England and France, it is only because of the general mix-up that occurred at the time of this Ice catastrophe, which seems to have been an event quite subsequent to the other geological work. The whole question is at present in too complicated a state to admit of very definite solution; and on this account, the author has preferred to use only the *argumentum ad hominem* which takes these geological distinctions and classifications as commonly understood. The drawing of a dinosaur which was discovered by the Doheny Scientific Expedition in 1924 on the walls of the Hava Supai Cañon, Arizona, would prove that some men must have been well acquainted with the dinosaur while alive; but it would not necessarily prove that this drawing was made while the dinosaur was still alive in North America.

In reality, the question is very simple: Are human remains found in the real fossiliferous rocks? Is man found fossil like the other animals? Geologists universally answer in the affirmative, and say that human remains have been found in the Pleistocene, the Pliocene, or even in the Miocene rocks.

IX

We may now proceed to inquire what geological changes have occurred since the "Miocene," according to the accepted teachings of geology. We may consider these changes under three heads:

1. Our first point must be that of climate; and I have already given abundant evidence to show that at that "time," an abundant warm-climate vegetation mantled all the arctic regions. As already quoted from Wallace, throughout the whole arctic regions, and during the whole of geological time, "we find one uniform climatic aspect of the fossils," and "it is quite impossible to ignore or evade the force of the testimony as to the continuous warm climate of the north temperate and polar zones throughout Tertiary times."

That this astonishingly mild and uniform climate prevailed over these regions until and during the time of the mammoth, we ought not to have a shadow of doubt. What single bit of positive evidence is there to show that it did not? That he must have had some such vegetation on which to feed is certain, and there is no proof of any previous interruption of these conditions save a series of hypotheses. He

and his fellows browsed on semitropical and warm temperate plants far within the arctic circle, if there happened to be land there, doubtless over the very pole itself; but suddenly, lo, something caught him with the grip of death—

> "And wrapped his corpse in winding sheet of ice,
> And sung the requiem of his shivering ghost."

Who has not read of their untainted meat now making food for dogs and wolves? Their stomachs are well filled with undigested food, showing, as one author remarks, that they "were quietly feeding when the crisis came." Dr. Hertz recently reported one not only with its stomach full of food, but with its mouth full too. No wonder that even an orthodox geologist like Professor Dana is compelled to say that these things prove "that the cold finally became *suddenly* extreme, as of a single winter's night, and knew no relenting afterward."

Here, then, is one very notable geological event which has taken place within the human epoch, and the only thing of its kind of which geology has an undeniable record; namely, a sudden and radical change in the earth's climate,—*a cosmic affair, and not a local phenomenon.* I need not here attempt to discuss the how of this world-catastrophe as it must have been, or the other changes inseparably involved. The fact itself is as certain as man's own existence.

2. The next division of our subject, in further consideration of the changes that have taken place since man's existence, as stated at the beginning of this

chapter, relates to the changes of land and water distribution since "Miocene times." And here again I shall take the classification of these rocks just as I find them.

The first thing which impresses us is the extremely fragmentary distribution of the Miocene and Pliocene beds. Not, however, that they are uncommon or yet of small extent. On the contrary, they are scattered over America and Eurasia — and all the rest of the globe for that matter — like the spots on a leopard, or the warts on a toad's back, till it becomes one of the unsearchable mysteries of the science how these innumerable patches can be got down under the ocean to receive their load of sediment, without deluging the surrounding regions in a similar manner. But then, to be sure, fresh-water lakes will answer the same purpose, and are particularly indicated(?) when the *proportion* of plants and terrestrial animals is in excess of the true marine fossils. And so enormous fresh-water basins are described here and there, with the great mammals crowding about their margins in their zeal to become fossilized, that the mountain tops may be saved from going under once more — or perhaps I should say, to enable the modern writers to get some of these strata puckered up to their full height before these "late" Tertiary deposits were made. This mountain-making business is another affair that geologists would like to have take place on the installment plan; but unfortunately, it seems to have been nearly all postponed till the very close of "geological time." This arrangement of

fresh-water lakes saves the central Rocky Mountain region from going down again beneath the deep. But it can not save the Alps, Juras, and Apennines in Europe, nor the Himalayas and most of the other mountains in Asia, nor the coast region of California and Oregon in America, to say nothing of large parts of the Andes in South America, with regions in Africa and Australia.

But what is the use of trying to figure out the amount of our earth which has been under the ocean since "Middle Tertiary times," and thus since man was upon it? To save the northern half of Europe with all of Canada from again going under at the close of the "Tertiary period," geologists have spread out their continental ice sheets, and have asked them to do duty instead of water. But this is hardly sufficient, for the "upper" or "later" part of the so-called "Glacial" deposits are clearly stratified; and hence they either invoke a *"flood vast beyond conception,"* as Dana does in America for the "final event in the history of the glacier," or, as others prefer, the whole region is baptized again. As Dawson says in his "Meeting-Place of Geology and History," "No geological fact can be better established than the Post-Glacial subsidence."

But I must not weary the reader by dwelling on this monotonous repetition of catastrophes — for must they not have been catastrophic if such ups and downs of whole continents are crowded within the human period? We may allow a number of thousands of years for man's possible existence, but

archæology and history alike protest against the millions of years required to explain these continental oscillations on any basis of uniformity. One such period of horror ought to be enough for us; and to understand or explain it in a truly scientific manner, we must with it correlate the sudden and world-wide change of climate already described.

3. One more point demands consideration ere we complete this subject of what man has witnessed of geological change. For, according to current theory, *almost all the mountains have been either wholly formed or at least completed within quite "recent" times;* indeed, many of the greatest mountain chains have been lifted up from the position of horizontal strata beneath the sea wholly since "Miocene times," which, for us, means since man was upon the globe.

Thus Dana, in speaking of the part of western America which has been elevated since "Miocene times," says that it "probably included the whole of the Pacific mountain border, from the line of the Mississippi Valley to the Pacific coast line and outside of this line for one or more scores of miles."[11]

And he adds the significant words:

"Contemporaneously, similar movements were in progress over the other continents: along the Andes, affecting half, at least, of South America; the Pyrenees, Carpathians, Alps, and a large part of Europe; the Himalayas and much of Asia."[12]

As is very evident, the uplifting of the mountains could not have taken place until after the very last of the strata composing them had been deposited by

[11] "Manual," p. 364.
[12] Id., p. 365.

the waters; and the progress of discovery has resulted in finding most astonishingly "young" strata in almost all of our great mountain systems. In fact, this subject of mountain making has become almost a painful one with geologists; so much so that in some of the very recent textbooks this phase of the subject is scarcely alluded to at all; in some of them it is not even mentioned.

But Bailey Willis, in his trip through Asia, came back with the wonderful announcement that throughout that continent "the greatest mountain chains challenge credulity by the evidence of their extreme youth."[13] He further declares that the uplifting of this continent with all its great mountain ranges "appears to fall chiefly within the Quaternary, but may extend back into the Pliocene."[14]

Thus we reach the very surprising conclusion that practically all the great mountain ranges of the globe must have been uplifted at about *one time;* and, moreover, this time is about the *last* thing on the geological program, and *certainly falls within the human epoch,* even according to the classification under the current theories. No wonder Dana says that this fact "is one of the most marvelous in geological history."

"It has been thought incredible that the orographic climax should have come so near the end of geological time, instead of in an early age when the crust had a plastic layer beneath, and was free to move; yet the fact is beyond question."[15]

[13] "Research in Asia," Vol. 2, p. 24.
[14] Id., p. 99.
[15] "Manual," p. 1020.

I think I have now abundantly proved the various heads of the proposition with which I began this chapter, taking them in reverse order; namely, that even from the standpoint of the current theories,[16]

1. Man must have seen the entire elevation or at least the completion of practically all the great mountains of the world, such as the Rockies, the Andes, the Alps, the Carpathians, the Caucasus, the Himalayas, etc.

2. The relative distribution of land and water surface has — since man's advent as commonly stated — changed completely. The land and the water have practically changed places over the greater part of the globe.

3. Man lived while the arctic regions had a mild, soft climate, and he lived to see these conditions so suddenly changed that some of his dumb brute com-

[16] In this discussion, I have purposely ignored the various instances where human remains have been reported from deposits of even greater "antiquity" than the Middle Tertiaries. For instance, there was published anonymously in 1857, by Judd & Glass, London, a book entitled "Voices from the Rocks; or Proofs of the Existence of Man During the Paleozoic or Most Ancient Period of the Earth." This book was carefully and candidly written in the light of the best knowledge then obtainable, for it was during the very heat of the discussion as to whether or not man is ever found in the fossil state. Some of the examples there recorded have since been "explained" in one way or another, while others have been ignored entirely. Other reports of human remains' having been found in Paleozoic or Mesozoic rocks appear now and then, but are soon laughed out of countenance by scientific ridicule, and never find their way into orthodox scientific literature. The following words, quoted from the book mentioned above, are just as pertinent to-day regarding the attitude of the current geology toward new facts which disagree with the popular theories: "These discoveries are so clear and incontrovertible that impartial inquirers after truth are amazed at the obstinacy with which geologists persist in shutting their eyes to the real facts in the case. The world affords no parallel to such conduct, unless, perhaps, that of the Church of Rome in reference to the discoveries of Galileo."— *Page 142.*

panions were caught in the waters and frozen so speedily that their flesh has remained untainted. Other considerations show this change of climate to have affected the whole globe.

The lesson to be drawn from this fact about fossil man as the last fact in the line of cumulative evidence relating to the fossil world, will be considered in the following chapter.

CHAPTER XIII

Scientific Methods

I

In Part One of this book, we examined the methods of reasoning and also the leading facts which are commonly adduced to show that there has been a succession of various kinds of life upon the globe, the various kinds occurring in a very definite order of sequence. We found that this life-succession theory was never anything more than a theory, and that it is now contradicted by many large facts; that from the early days of geology this theory never was the result of careful and patient research or the result of employing scientific methods, but was the snap judgment of the early geological investigators, impatient to solve a great world problem, and quite unwilling to await the results of a genuine world-wide investigation. We further found that the notorious geological "ages" are without any true scientific foundation; and that no one kind of fossil has ever been proved or can be proved to be intrinsically and always older than another, or than man himself. Hence a complete reconstruction of geological theory is imperatively demanded by our modern knowledge.

In short, that ancient world, whose ruins we now have as fossils, was a *unit*, and simply an older state of our present world. All the important groups of

living plants and animals have now been found as fossils, and their classification does not represent a time-value in the one case any more than in the other. The geological series of fossils represents merely taxonomic relationships, just as would a similar arrangement of the living species, nothing more.

In Part Two, the following additional facts have been brought out:

1. The abnormal character of much of the fossiliferous deposits.

2. A radical and world-wide change of climate.

3. The marked degeneration in passing from the fossil world to the modern one.

4. The fact that the human race, to say nothing of a vast number of living species of plants and animals, has participated in some of the greatest of the geological changes — we really know not how to limit the number or character of these changes.

These additional facts still further emphasize the unity or solidarity of that ancient world. They show how all its parts are indissolubly bound together in a common fate, and how sharply and distinctly it is differentiated from our modern world by an impassable boundary line of world-wide geological changes that true science can never ignore.

II

Surely a true spirit of scientific investigation would now begin to inquire, *How did these changes take place?* Can we continue to assume uniformity in the face of such facts as these?

In any truly heuristic or Baconian study of geology as a whole, the rocks of the so-called "Glacial age" and the Tertiaries, *the surface rocks* (at least on the surface in England and Germany where first examined), will not be, as Zittel says they have been, "the last to be understood," and only attacked after geological history had been started away back in eternity, and all the details of the successive ages had been arranged according to the doctrine of uniformity and *a priori* methods of reasoning, with the very natural result that, failing to make a good splice of these two ends of our slipshod investigations, we have for over half a century been laboring under a "glacial nightmare," and these deposits on the very top of the ground "still remain in many respects the despair of geology."

Even now, in this third decade of the twentieth century, a good deal more time is spent in groping around among the gneisses, schists, and granites of the Archæan, trying to find some beds a little "older" than any hitherto discovered, than there is spent in a rational consideration of the connection between the fossil world and our modern one, and how the one was really changed over into the other.

But there is no science in all this. Is it scientific to start with what we know the least about, and force our more accurate knowledge of things at hand to square with our theories of things more remote? The current evolutionary geology has never used a trace of sound Baconian science in these fundamental principles and methods, but, as a burlesque on inductive

science, has always started with *some hypothetically oldest forms,* and after having located them at the vanishing point of the vistas of a past eternity, has trusted to its skill in dead reckoning to be able to work up by slow stages to the present, and to arrive here with a sufficiently small cargo of "living" species undisposed of to splice on to the present smoothly and safely on the basis of uniformity and slow secular change. Such is geology by hypothesis —from the subjective standpoint. Such is the beginning, the outline, of the entire scheme of organic evolution. It is a kind of "science" by which some people have for a century or so tried to explain the known in terms of the less known or the unknown. Such are the methods "which dominated medieval scholasticism and made it so barren."

III

It requires no scientific instruments of precision to recognize in all this a mere travesty on the methods of Bacon and Newton; and it requires but little training in the latter to suggest the better way. Let us throw to the winds all speculations as to how the world was made, and hold our restive imaginations within the bounds of legitimate science by the strong rein of demonstrable fact, content if we can really explain a few things that have happened since the beginning. And let us start with the most obvious facts on hand, namely, *man and all the living species of plants and animals;* and with all inherited prejudices about "extinct species" cast aside, by working

back among the strata, let us find where and how their fossils occur, and then decide as best we can how they were placed there, and how the intervening changes took place. Focusing our attention on all the human remains of real geological age wherever found, and on the fossils of *all species of plants and animals now living anywhere on earth,* let us, with all the known facts of biology, paleontology, and meteorology, endeavor to reconstruct the flora and fauna of that ancient world and the marvelously uniform climate in which they lived. And after having thus obtained a good, broad view of the fossil world *as a whole,* we may possibly be prepared to determine how that almost Eden-like world was transformed, by a sudden and awful catastrophe, into this wholly different modern world with which we are familiar. Then, *whatever rocks we have left over* after these things are decided, we may very safely assign to the indefinite and (in a scientific way) indeterminable period of the earth's previous existence. This is the only method fit to be termed scientific.

We have an almost exact analogy (on a small scale) to all this in the science of psychology, where the investigator wishes to determine how processes of thinking or association of ideas are built up out of the comparatively simple sensations first experienced by the infant. The older psychologists used to assume these simple original sensations, and would work up from this (hypothetical) infantile experience to the experiences of mature life. But this method is now seen to be unscientific and fallacious. The new or

scientific psychology no longer attempts to start from any assumed simple infantile experiences; it contents itself with working from the present back into the past, as best it can, well aware that this is the only truly scientific method.[1]

This former method in psychology, which is now seen to be unreliable and contrary to sound scientific principles, is exactly analogous to the prevailing methods in geology, which I am here contending are equally unreliable and equally contrary to sound scientific principles. Both psychology and geology are historical investigations (the former on a somewhat small scale); but both are handicapped by difficulties which are inherent in the very nature of the subject which is being investigated. But because of these natural difficulties, it is all the more important that we adhere to sound inductive methods if we want our results to be considered more than a tissue of guesses.

IV

Surely it is little short of absolute nonsense to begin somewhere away back in eternity, and, contrary to our universal modern experience, dogmatize about certain times back there when there were no zoölogical provinces and districts, but only one and the same assemblage of living creatures everywhere on earth, and on the strength of this unnatural, this monstrous assumption, formulate our pretty theories as to how this deposit was made, and how that was laid down,

[1] "Mysticism," etc., Knight Dunlap, p. 149.

and the exact order in which they all occurred; while these "recent" deposits, in which our race and all our companion plants and animals are acknowledged to be concerned, are left over till the last, and we then find that the two worlds, the ancient and the modern, are incommensurable, and, as Howorth and Suess have so clearly shown, the ancient can never be made to splice on to our modern conditions. Thus we ourselves, to say nothing of thousands of living species of plants and animals, have participated in some of the very greatest of the geological changes — we know not how many or how great. *These things should first be explained.* Has anything happened to our world that will explain them? Are there known forces and changes now in operation which, granted time enough, will amply and sufficiently explain these facts as simply one in kind with those of the present day?

To this last question, we must admit that our historic experience, prolonged over several thousand years, utters a thundering NO! Volcanoes are every now and then breaking forth; but volcanoes and mountain ranges have nothing in common with one another as to structure and origin. No one claims that a single mountain flexure is now being formed or has been formed within the historic period; while, as Suess remarks, "the formation of mountains evidently belongs to *quite another series of phenomena*" from the great exchanges of ocean and dry land that once took place.[2] There are indeed "creeps" in the

[2] "The Face of the Earth," Preface, p. 5.

rocks in certain places, but these are not such as to contribute to the height of the mountains in which they occur, but rather the reverse. Sudden changes of level within small areas have occurred, but neither in extent nor in kind do they furnish any key to past changes of level; while the so-called "secular" changes are so microscopic in amount and so ambiguous in character, indeed so doubtful as to reality, that they are utterly unworthy of consideration in view of the tremendous problems which we are trying to explain. The great work of Eduard Suess has demonstrated conclusively that, to quote his own words, "the theory of the secular oscillations of the continents is not competent to explain the repeated inundation and emergence of the land";[3] for even in those localities, like Sweden and Greenland, which have been supposed to be rising or falling, "displacements susceptible of measurement have not occurred within the historic period."[4]

In fact, this most accomplished scientist, after summing up the whole wisdom of modern science on these subjects, writes the epitaph of the old uniformitarianism in such language as the following:

> "Thus, as our knowledge becomes more exact, the less are we able to entertain those theories which are generally offered in explanation of the repeated inundation and emergence of the continents."[5]

As a destructive criticism of the current theories by which the doctrine of uniformity has sought to

[3] Vol. 2, p. 540.
[4] Id., p. 497.
[5] Id., p. 295.

justify itself by appealing to processes alleged to be now going on, Suess's work is masterly and unanswerable. But when we seek in it for a constructive explanation of how the past geological changes have occurred, we not only get no satisfactory answer, but practically no answer at all. Suess repeatedly expresses his amazement at the regularity and periodicity with which the ocean must have come up over the continents. Zittel, in commenting upon Suess's great work, acknowledges that Suess has no solution for the way in which the past exchange of land and water took place,—or, as Zittel expresses it, the great problem of "the periodic recurrence of those great pelagic transgressions, whose cause of origin until now has not yet been discovered."[6]

And Zittel quotes with approval the following "mystic-sounding sentence," with which Suess closes his discussion of this very subject:

> "As Rama looks across the ocean of the universe, and sees its surface blend in the distant horizon with the dipping sky, and as he considers if indeed a path might be built far out into the almost immeasurable space, so we gaze over the ocean of the ages, but no sign of a shore shows itself to our view."[7]

With uniformity thus acknowledged to be bankrupt, we may turn our attention to the one remaining division of our problem, namely, the question of a world-wide and sudden change of climate.

But I never heard anyone suggest that cosmic changes of climate are now known to be going on,

[6] "History of Geology and Paleontology," p. 320.
[7] "The Face of the Earth," Vol. 2, p. 703, Zittel's translation.

much less that sudden changes of the kind indicated by the North Siberian "mummies" are in the habit of occurring. We must all own that the mountains, the relative position of land and water, as well as the climate of our globe, are each and all now in a state of stable equilibrium, and have been in this state since the dawn of history or of scientific observation.

V

Accordingly, I ask, *How much time is needed* to account for the facts before us on the basis of this bankrupt uniformity? Indeed, will a short eternity itself satisfy the stern problem before us? I can not see that it holds out the slightest promise of a solution; while, on the other hand, I am sure that, in dealing with the past of man's existence (theories of evolution and all other theories of origins whatever cast aside), we are not at liberty to make unreasonable demands on time. The evidence of history and archæology is all against it.

From the latter sciences, it can be shown that at their very dawn, we have, over all the continents, a group of civilizations seldom equaled since, except in very modern times, and all so undeniably related to one another and of such a character that they prove a previous state of civilization in some locality together, before these scattered fragments of our race were dispersed abroad.[8] We can track these various peoples all back to some region in southwestern Asia, though the exact locality for this

[8] On this point, see "The Children of the Sun," by W. J. Perry, London, 1923.

source of inherited civilization has never yet been found,[9] and the evidence is now almost conclusive that it is somehow lost in the geological changes which have intervened. For when we cross the well-marked boundary line between history and geology (if the paleolithic remains of western Europe are really of geological age), we have still to deal with men who apparently were not savages, men who, with tremendous disadvantages, could carve and draw and paint as no savages have ever done, and who had evidently domesticated the horse and other animals. But as to time, history gives no countenance to long time—that is, to what geologists would call long. Authentic history extends back a few score centuries; archæology may promise us a few more. As for millions of years, or even a few hundred thousand, the thing seems too absurd for discussion, unless we forsake inductive methods, and assume some form of evolution *a priori,* and contrary to all experience and all the evidence.

At any rate, as we have seen, human remains are found fossil just the same as other forms of life, and there is absolutely no way of proving that these fossil men are not as old as any other fossils. Whatever proves the latter old does the same for man; but if we insist on the comparatively "modern" character of these fossil human remains, we must admit the same for all the other fossils, because inductive science insists that the fossil world was a

[9] A remarkable work by R. A. Fessenden, entitled "The Deluged Civilization of the Caucasus Isthmus," Boston, 1923, seems to track the Greeks and most of the other races back to the Caucasus isthmus.

unit, and that man must have been contemporary with all alike. True science can never take us back of this state when all existed contemporaneously; for it would require a supernatural knowledge of the past to discriminate among the fossils, and say that one particular group existed before the others and occupied the world exclusively for ages before they came into existence. As we have seen, all efforts thus to lay out a history of organic creation as Cuvier's "glorious" vision pictured it to him, have ended in a miserable failure, because such efforts are along lines so false in method that they are rapidly making geology a laughingstock to the other sciences, founded on the principles of Bacon and Newton. *The fossil world is a unit, and simply represents the ruins of an older state of our present world; and whatever geological changes they indicate, must have taken place since man was on the earth, for there is no possible line of scientific reasoning to convince us that any single type of fossil is older than the human race.*

Hence it ought to be evident that no amount of learned trifling with time will solve our problem without supposing some strange event to have happened to our world and our race, long ago, and before the dawn of history. I see no possible way for scientific reasoning to avoid this conclusion. Ignoring for the present the Chaldean Deluge tablets, and what Rawlinson calls the "consentient belief" in a world-catastrophe "among members of all the great races into which ethnologists have divided mankind," which, like their civilization, has the hall marks of being

an inheritance from some common source before their dispersion, we may note that most geologists now admit the certainty of some sort of catastrophe since man was upon the earth. I might mention Quatrefages and Dupont, Boyd Dawkins, Howorth, Prestwich, Wright, and Sir William Dawson, with many others. Even Eduard Suess teaches a somewhat similar local catastrophe, though, like the others, only as a reluctant concession to the insistent demands of Chaldean history and archæological tradition. But all these affairs are mere makeshifts in view of the tremendous demands of the purely geological evidence, and all alike (save perhaps those of Wright and Howorth) labor under the strange inconsistency of supposing that such an event could occur without leaving abundant and indelible marks upon the rocks of our globe; while, in view of the evidence given through the previous pages, I insist that the purely geological evidence of a world-catastrophe is immeasurably stronger than even the evidence of archæology —that in fact the whole of the geological phenomena constitutes a cumulative argument of this nature.

VI

But if this be granted, we must then inquire, What was its nature? and what its extent? The former problem is quite easily answered; the latter is still somewhat beyond our reach.

As to its character, the evidence is very plain. It was a veritable cataclysm of some sort; it deals with great changes of land and water surface. If

the life-succession is but a hoary myth, and if we find countless modern living species of plants and animals mixed up in all the "older" rocks, we can not ignore these in a rational and unprejudiced reconstruction of the science. But, ignoring these, we must remember that *even the Tertiary and Post-Tertiary deposits are absolutely world-wide, and are packed with fossils of living species.* Not a continent and scarcely a country on the globe but contains great stretches of these latter deposits, laid down by the sea where now the land is high and dry. The sea and the land have practically shifted places over all the globe since man and thousands of other living species left their fossils in the rocks. It is only the stupendous magnitude of these changes which has made our scientists reluctant to admit the possibility of such a catastrophe.

With the myth of a life-succession dissipated, a broad view of the fossil world can not fail to convince the mind of the reality of some such cosmic convulsion, and convince it with all the force of a mathematical demonstration. Great groups of animals have dropped out of sight over all the continents, and their carcasses have been buried by sea water where we now find high plateaus or mountain ranges. Ignoring again, for the moment, the abundant fossils in the so-called "older" rocks, and fixing our attention entirely on the Tertiary and Pleistocene beds that are acknowledged to be closely connected with the human race and the modern world, we still have a problem in race extinction alone that appalls the mind. The

mammoth, the rhinoceros, the camel, the huge ground sloth, the saber-tooth tiger, and the mastodon, together with "not less than thirty distinct species of the horse tribe," as Marsh says, all disappear from North America at one time, and the most ingenious disciple of Hutton and Lyell has been puzzled to invent a plausible explanation. But when we consider that at this same "geological period," similar events were occurring on all the other continents — the huge ground sloths (megatheriums) and glyptodons in South America; wombats as large as tapirs, and kangaroos the size of elephants, in Australia; the mammoth and the woolly rhinoceros in Eurasia; together with an enormous hippopotamus, as far as England is concerned; to say nothing of those great bears, lions, and hyenas, with a semitropical vegetation, *all disappearing together at the same time,* or shifting to the other side of the world — it becomes almost like a deliberate bribe to our intellectual honesty to be approached with offers of "explanations" based on any so-called "natural" action of the forces of nature. None but a mind long debauched by unscientific theories and illogical methods of reasoning, would ever attempt to defend geological uniformity in the face of such facts as these. But when, in addition to all this, we consider the fact that those human beings of the deposits of western Europe were contemporary with the animals mentioned above, and disappeared along with them at this same time, *while mountain masses in all parts of the world, crowded with marine forms of the so-called "older" types,*

positively can not be separated in time from the others, it becomes as certain as any other ordinary scientific fact, like the capture of Babylon or the burning of Carthage, that our once magnificently stocked world met with some sudden and awful catastrophe in the long ago; and is it in any way transgressing the bounds of true inductive science to correlate this event with the Deluge of the Hebrew Scriptures and the traditions of every race on earth?

We have already seen how Dana supposes *two* other such events, one at the close of the "Paleozoic age," and the other at the close of the "Mesozoic," merely to account for the astonishing disappearance of species at these periods when the fossils are arranged in taxonomic order. But if we once admit one such event, *with man and all the other species contemporary with one another,* where shall we limit its power to disturb the land and the water and churn them all up together, leaving the present simply as the ruins of that previous world? Or how shall we proceed, on sound scientific principles, to discriminate between the extinct fossils that may have had to run the gauntlet of such an aqueous convulsion, and decide that only a certain limited few of them had their extinction due to this event, and then tabulate the others off on the percentage system, as if such a catastrophe had never happened? The fact is, the current geology is wholly built up, from the Cambrian to the Pleistocene, on the *dogmatic denial* that any such catastrophe has occurred to the world in which man lived; for *one* such event happening in our

modern interdependent world is enough to make the whole pretty scheme found in our textbooks tumble like a house of cards. Like the patient and exact observations of the Ptolemaic astronomers, which accumulated volumes of evidence contradicting their own theories, and which, in the hands of Copernicus and Galileo, Kepler and Newton, sealed the doom of astronomical speculation and laid the foundations of an exact science of the heavens; so have the indefatigable labors of thousands of geologists accumulated evidence which strikes at the very foundation of the current uniformitarianism, and casts a pall of doubt over every conclusion as to how or when any given deposit of the "older" rocks was produced.

VII

Here inductive science must leave the question for the present. The possibility of such a world-wide catastrophe, which might account for the major part of the geological changes, needs no apology here. The slightest disturbance of the nice equilibrium of our elements would suffice to send the waters of the ocean careering over the land; and in the abundance of astronomical causes competent for such disturbance, we cease to regard such an event as necessarily contrary to "natural law." The possibility of such a thing no competent scientist now denies; it is the problem of *recovery* from such a disaster which makes the perplexity. But incredible or not as the latter may be regarded, I claim to have established a perfect chain of scientific argument proving a

world-wide catastrophe of some sort since man was on the earth. But this fact, if once admitted, strikes at the very foundation of the current evolutionary theory, and bids us readjust our theories from this viewpoint. The venerable scheme of life-succession *becomes only the taxonomic, or classification, series of the world that existed before this disaster;* and it becomes the business of our science to try to find out how many and what deposits were due to this event, and what were accumulated during the unknown period of previous existence. Those of us who wish to speculate can then let our imaginations have free play as to the uncounted ages before that event; but the "phylogenic series" as a rational scientific theory is in limbo forever. Inductive geology, therefore, deals not with the formation of a world, but with the ruins of one; it furnishes us no materials for constructing a cosmogony — that is, nothing as to the details or order in which creation took place, though, as we have seen, it *indirectly* proclaims the general fact of a literal creation in no uncertain tones.

But this latter problem lies across the boundary line, in the domain of philosophy and theology; and to these systems of thought we may cheerfully leave the task of readjustment in view of the facts here presented.

CHAPTER XIV

Reflections

I

In the preceding pages I have tried to give a purely scientific argument, first against the traditional theory of successive types of life, and secondly against the dogma of uniformity. The two lines of thought are intimately connected; and it is obvious that if the successive-ages theory is discredited, uniformity becomes utterly unthinkable. In that case, a catastrophic interpretation of the chief geological phenomena becomes quite inevitable. What things are further implied because of this, may well be worthy of a little attention.

For if there really has been a world-catastrophe, such as seems to be indicated by the geological evidence, this fact can never be permitted to stand as an isolated fact in our thinking, with absolutely no further influence upon our other ideas of nature and of the universe. If we are to act as rational creatures, this fact of a great world-cataclysm must be given its proper place and be allowed its proper influence on the rest of our thinking. That is, we must make a proper adjustment of our philosophy; for philosophy is only a general view of the problems of nature and their correlation with human values and

human destiny. Every man has some sort of philosophy, adequate or inadequate; but the philosophy of the man who is convinced of the catastrophic interpretation of the geological phenomena will be vastly different from the philosophy of the one who believes in an absolute uniformity of nature; yes, very different,—as different as creation is different from evolution.

The bearings of the catastrophic theory of geology upon the doctrine of creation have been discussed by the present writer in various publications, particularly in "Q. E. D."[1] This phase of the matter need not be repeated here. It remains to consider briefly the various possible alternatives of a strict system of natural science toward the facts brought out in the previous pages.

II

Personally, I can see only two possible methods of adjustment, in view of the facts of geology as we now know them:

1. Scientists may adopt an agnostic attitude, and say that, although they have been disappointed in tracing out the beginning of things by means of the fossils, nevertheless they still believe that somehow life has been on the globe for an immensely long time, and that it *may* have come about by progression from crude or scanty beginnings. Of course, this can not be proved, and the more candid will readily admit

[1] "Q. E. D., or New Light on the Doctrine of Creation," New York, 1917.

this; but rather than face the other alternative, many will probably adopt this attitude.

To do this, they will have to shut their eyes to any real candid or philosophical explanation of the general facts of the rocks. But these people may refuse to attempt any explanation of the general facts. They may simply say, as a leading state geologist once said to me, that he had done with general theories about the past of the world; he was simply noting the facts in the field, and trying to explain them locally, caring nothing whatever about a world philosophy of geology. This may be an easy way out of the difficulty for some people, but it seems very inadequate to me.

2. The only other alternative, as it seems to me, is to say that this world-cataclysm, so clearly indicated by the new geology, must correspond to the Deluge spoken of in Genesis. But on this basis, this deluge must have been a much vaster and much more important event than it has usually been considered. It would seem that nothing but a specially planned event, that is, what we understand as a "supernatural" event, must be indicated both by the Scriptural record and also by the geological. Conceivably, if there were enough loose materials on hand in various parts of the earth, that is, enough clay, sand, and gravel, etc., a huge world-convulsion might pick them up here and there and rearrange them in strata or layers, much as we find them now, their present consolidated condition being easily accounted for by the subsequent "setting" of the materials, due to chemical and mechanical action.

III

I have discussed a possible cause for such a world disaster in Chapter XLI of "The New Geology." It was evidently due to what we might call purely "natural" causes, if we could know all the facts. But to us there seems a strangeness, an awfulness, about the whole affair, both as described in the Bible and as portrayed in the strata, when considered as a real world-cataclysm. However, when we finally become accustomed to the idea, the question begins to fasten itself upon us, If there was such a huge world-catastrophe, how did the human race and the animals possibly escape complete annihilation?

The Bible pictures this rescue of a few men and a stock of animals as being due to God's direct care, or providence. This, too, becomes all that we understand by the word "miracle"; and no one is likely to adopt this interpretation of the changes recorded in the rocks who can not admit God's special interposition in the affairs of the world. To me it seems of little use for us to give a nominal assent to such miracles as the incarnation, the resurrection of Christ, and predictive prophecy, if we can not bring ourselves to believe such an event as a world-deluge to be possible, when the very stones are now crying out that the Bible record must be true.

That many (but minor) scientific objections can be raised against this interpretation, can not be regarded as entirely precluding this as the true explanation of the facts of the rocks. It would be quite unreason-

able to ask us to explain in detail just how everything took place, both in the way of the formation of the strata and in the recovery of the world by the subsequent redistribution of mankind and the animals over the earth. That there are very many of the details which are difficult to explain, it would be idle to deny; and I have no disposition to deny these difficulties. All that I claim for this view is that the rocks seem positively to indicate some huge world-catastrophe; and if we believe the Bible, this scientific event seems to be the counterpart of the event recorded in the early part of the Bible and also preserved to us in the tradition of almost every race on earth.

I do not think that natural science ought to be expected to do more than this for the great truths of religion. It may remove obstacles, as this catastrophic interpretation has effectually removed the old and seemingly insuperable difficulty of harmonizing the Bible with the evolutionary account of the beginning of our world. The latter turns out to be only a big blunder; and the Bible record is far easier to believe than the fairy tales of evolutionary geology. But we must not expect even a true view of natural science to do much more than this. It removes difficulties, and thus makes it possible for us to believe. To do more than this would be to coerce our minds, leaving no room for faith. It requires no faith to believe in a mathematical demonstration or to believe in the existence of Tibet or Kabul, though few of us have been to either place. In such instances, the mind is coerced; it can not refuse assent. Evidently God

does not want to deal with us in this way regarding the great moral truths and the truths of religion. All these are of such a nature that we can refuse to believe them if we wish to do so or if we decide to do so. At the same time, ample evidence is granted to all those who are willing to examine the evidence with an absolutely candid mind. "If any man willeth to do His will, he shall know of the teaching."[2]

But there is one thing that the public has a right to expect henceforth from geologists, and from other scientists in general whenever the latter have occasion to speak of geological results. The great lay public, who necessarily have to take their views of geology and biology from the experts in these sciences, have a right to be able to trust these experts; they have a right to perfect honesty and candor in the presentation of the great general facts of natural science. They have a right to expect that their guides in geology and in the other branches of natural science will clearly differentiate between facts and speculative theories. Theories are all right in their place; we can not make any progress without many theories. And the experts may think that they themselves can correctly distinguish between proved facts and mere speculations, and can constantly evaluate each. But the public, and above all the students in our colleges and universities, have a right from henceforth to expect perfect candor and honesty in distinguishing between the actual facts of geology and those speculative theories which have so long and so obscuringly

[2] John 7:17, A. R. V.

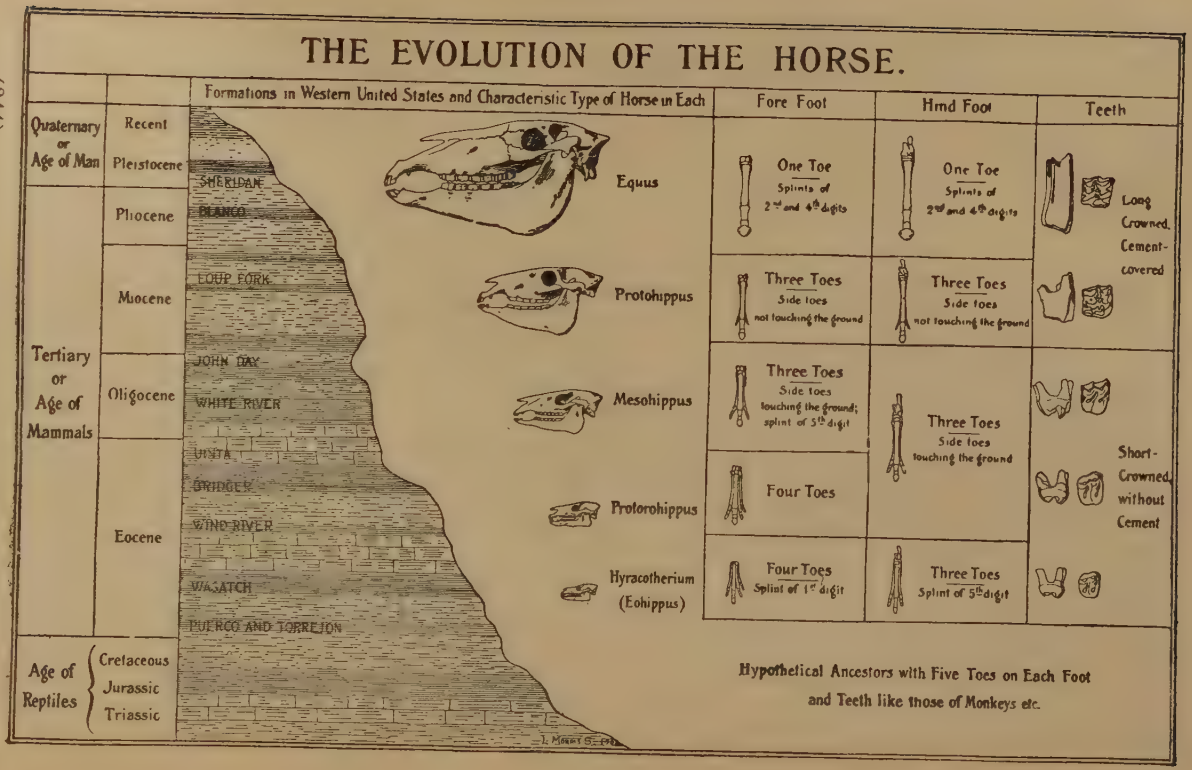

THE EVOLUTION OF THE HORSE.
Formations in Western United States and Characteristic Type of Horse in Each
Fore Foot
Hind Foot
Teeth
Quaternary or Age of Man
Recent
Pleistocene
Tertiary or Age of Mammals
Pliocene
Miocene
Oligocene
Eocene
Age of Reptiles
Cretaceous
Jurassic
Triassic
SHERIDAN
BLANCO
LOUP FORK
JOHN DAY
WHITE RIVER
UINTA
BRIDGER
WIND RIVER
WASATCH
PUERCO AND TORREJON
Equus
Protohippus
Mesohippus
Protorohippus
Hyracotherium (Eohippus)
One Toe
Splints of 2nd and 4th digits
One Toe
Splints of 2nd and 4th digits
Three Toes
Side toes not touching the ground
Three Toes
Side toes not touching the ground
Three Toes
Side toes touching the ground; splint of 5th digit
Three Toes
Side toes touching the ground
Four Toes
Four Toes
Splint of 1st digit
Three Toes
Splint of 5th digit
Long Crowned, Cement-covered
Short-Crowned, without Cement
Hypothetical Ancestors with Five Toes on Each Foot and Teeth like those of Monkeys etc.

FIG. 99. One of the important facts to bear in mind when examining such a diagram as this, is that the formations here represented as superimposed upon one another, are not found thus in nature,—this is a purely artificial arrangement, made up from widely scattered formations, with nothing whatever of actual fact to forbid the idea that all these so-called "horses" were really living contemporaneously. Even the modern horse, Equus, is also found as a true fossil, along with the others, and became extinct in America (as far as we can tell) at the very same time as all these other animals, with the mammoth also, and the rhinoceros, the camel, the saber-tooth tiger, and the megatherium. This is a purely artificial table, designed to deceive only the ignorant. It is reproduced from the publications of the American Museum of Natural History, New York City.

FIG. 100. A serial but artificial arrangement of some skulls of apes and men, designed to track the ape origin of man. The fragments on the sloping background show the real original specimens from which these skulls have been "reconstructed." One might just as well schematize or arrange in [illegible] order samples of the bonnets of New York or Boston, and claim that such a series illustrates the evolution of the American bonnet. (American Museum of Natural History, New York City.)

dominated all biological research. The plea of academic *Lehrfreiheit*[3] will never suffice to justify the deceiving of the students and the public.

There have always been a few scientists here and there who do not see any particular harm in Haeckel's well-known methods of doctoring the diagrams of embryos and other structures and objects, and arguing in his books as if purely hypothetical animals had an objective existence. It has been claimed in defense of these methods that the people who really desire to know the actual facts can always differentiate Haeckel's facts from his theories. In the minds of those who have sought to justify these methods, Haeckel was not guilty of frauds and forgeries in the name of science. Such defenders of Haeckel can not be expected to see anything particularly wrong in the diagrams and schematized models of horses, elephants, camels, and other animals, as seen in many of our great museums, arranged in such a way as to appear to demonstrate objectively some scheme of organic evolution. Such persons can not be expected to acknowledge that these schematized arrangements of the fossils are actual frauds on the million or so school children and other visitors who periodically look upon these artificial representations and suppose them to be real facts, not mere illustrations of highly speculative theories.

And yet every clear thinker now knows that it is a pure fancy, with no objective support whatever, to say that the little four-toed animal, called a "horse"

[3] "Liberty to teach."

by courtesy, is a single day older than the larger three-toed animal alleged to be younger by uncounted thousands of years, or that either of these is a day older than the true one-toed horse which is also found in the fossil state, just as truly as the others.

I can not do more than call attention to the highly theoretical representations of the various grades of human relics, also placed in an alleged historical order, to illustrate man's rise from brute ancestors. These models, and the schematized evolution of the horses and other animals, are just as truly frauds and deceptions as are the very worst things ever done by Haeckel, though the tricky methods of the latter drew down upon the Jena naturalist the well-deserved execration of a large part of the foremost scientists of Germany.

But some of the diagrams of rock strata, drawn by geologists to illustrate their theory of folds and thrusts, to explain how "old" strata happen now to be found on top of "young" strata, are little better than the foregoing, and can not be defended from the point of view of strictly honest science. True, these diagrams usually attempt to distinguish between the visible outcrops and the imagined places where these strata once extended. Yet when we remember that all the lines, even those representing the real beds, are usually strongly *conventionalized,* in order to make the folds or thrusts seem more natural, we can better understand how far pure theory is imposed upon the mind of the reader as actual fact. Furthermore, when we realize how highly specialized the science of ge-

ology really has become, and how completely botanists, zoölogists, yes, psychologists, anthropologists, and even historians, are dependent upon the results of geology for many points in their own specialties, it becomes little less than an intellectual crime, a scholastic fraud, to continue to teach the old theories of geology in the old way; that is, in such a way that those who are not trained in geological methods can not distinguish the facts of geology from its purely speculative theories.

And what shall we say of those textbooks which continue to give us maps and descriptions of what are termed "paleogeography," telling us exactly how much was ocean, how much was dry land, etc., etc., in a certain hypothetical period in the long ago? They tell us, with oracular solemnity, that at this particular time only certain kinds of animals and plants were in existence; that this period was long ages *before* certain other animals lived, and was also long ages *after* certain other animals had all died off. And the students of botany, of zoölogy, and of anthropology, have long taken these dogmatisms as real facts, and have adjusted their own theories of their own specialties so as to accord with these dogmatisms of the geologists, supposing them to be actual facts.

How long is it going to be before we can have an honest differentiation between the facts and the theories of this science, as they are passed out to the public and to the students in our colleges and universities?

Hitherto, a man might claim that the terms Cambrian, Ordovician, Silurian, Cretaceous, Tertiary, etc., represent actual time-values which have been scientifically established, and might still be intellectually honest; for we did not know any better. We may still, I think, distinguish the Primary (or Primitive); the Cataclysmal; the Drift; and the Recent, as a rough chronology tolerably well established, though the actual field examples to illustrate each are not always certainly differentiated. Soon, however, for a man to claim actual time-distinctions for the formations, or for even such larger divisions as Cambrian, Devonian, Cretaceous, or Eocene, Miocene, and Pliocene, will brand him as either needlessly ignorant or clearly dishonest.

Lehrfreiheit? — Yes; but let it be only in truth, and with an honesty which will not bring a reproach upon the sacred name of natural science.

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